SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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THE BRITISH ASSOCIATION.

THIRTY-NINTH ANNIVERSARY, AT EXETER, AUGUST, 1869.

DIARY OF PROCEEDINGS.

Friday, Aug. 20.—The following is a list of the papers read in the different sections yesterday, independent of various addresses and scientific reports:—

IN SECTION A.—W. R. Birt: On Secular Variations of Lunar Tints. W. R. Birt: On Spots and Shadows on the Lunar Crater Plato. Prof. G. C. Foster: Description of some Lecture Experiments in Electricity. J. H. Gladstone: On the Relation between the Specific Refractive Energies and the Combining Proportions of Metals. G. J. Symons and R. Field: On the Best Means of Determining the True Evaporation from the Surface of Water. C. J. Woodward: On a Self-setting Type-machine recording the Horizontal Motion of the Air. Mr. Martin: Description of a new Self-recording Aneroid Barometer.

SECTION B.—M. Jacobi: On Electrolytic Iron. J. Moffat: On the Phosphorescence of the Sea and Ozone in connection with atmospheric conditions. J. Moffat: On the Oxidation of Phosphorus and the Quantity of Phosphoric Acid exerted by the Kidneys in connection with Atmospheric Conditions. C. Tomlinson: On a Remarkable Structural Appearance in Phosphorus.

SECTION C.—R. A. C. Godwin-Austen: The Devonian Group Considered Geologically and Geographically. P. M. Duncan, M.D.: Second Report of the Committee on British Fossil Corals. J. Thomson: Report of the Committee on Sections and Photographs of Coral. G. W. Ormerod: Sketch of Granite of the Northernly and Easternly Sides of Dartmoor. W. Pengelly: Source of the Miocene Clays of Bovey Tracey. T. Davidson: Notes on the Brachiopoda hitherto obtained from the "Pebble Bed" of Budleigh Salterton. E. Hull: On the Source of the Quartzose Conglomerates of the New Red Sandstone of Central England. H. Woodward: Fresh Water Deposits of the Valley of the River Lea, in Essex.

SECTION D.—DEPARTMENT OF ZOOLOGY AND BOTANY.—Rev. H. B. Tristram, F.R.S.: On the Effect of Legislation on the Extinction of Animals. F. F. Hallett: On the Law of the Development of Cereals. R. O. Cunningham: On the Flora of the Straits of Magellan and West Coast of Patagonia. R. O. Cunningham: On *Chionis alba*. C. E. Broome: On a lately-discovered *Mixogaster*. W. P. Hiern, M.A.: On the Occurrence of *Rapistrum rugosum*, All., in Surrey, Kent, and Somersetshire.——DEPARTMENT OF ANATOMY AND PHYSIOLOGY.—B. W. Richardson, F.R.S.: Report on the Physiological Action of the Methyl Series. E. Ray Lankester: Report on the Spectroscopic Examination of Animal Substances. Rev. W. V. Harcourt: The Solution of Urid Acid Calculi, and the Quantitative Analysis of Uric Acid. Dr. Wilson: The Moral Imbecility of Habitual Criminals Exemplified by Cranial Measurements.

SECTION E.—Dr. R. J. Mann: Erskine's Discovery of the Mouth of the Limpopo. Dr. Beke: On a Canal to Unite the Upper Nile and Red Sea. J. Stirling: Visit to the Holy City of Faz, in Morocco. Capt. T. P. White, R.E.: Bifurcating Stream in Perthshire. Capt. C. Dodd: Recent Visit to the Suez Canal. Lieut.-Colonel A. Strange, F.R.S.: On a Small Altazimuth Instrument for the use of Explorers.

SECTION F.—Canon Girdlestone: Maintenance of Schools in Rural Districts. J. Bayley Denton: Technical Education of the Agricultural Labourer. James Hunt Holley: Remarks on the Need of Science for the Development of Agriculture. Dr. L. Lindsay: The Sutherland Gold Diggings as a Scientific and Social Experiment. John Glover: Decline of Shipbuilding on the Thames.

SECTION G.—Colonel H. Clerk, R.A., F.R.S.—Description of the Hydraulic Buffer, and on the Flow of Liquids through Small Orifices at High Velocities. R. Eaton: On Certain Economical Improvements in Obtaining Motive Power.

The various interest of these communications would occupy more space than can at present be given with the slightest shadow of justice. Arrivals continue, the number of admissions now exceeding 1800 Members and Associates.

In the evening Prof. Phillips gave a lecture "On Vesuvius" to a large, brilliant, and exceedingly attentive audience. Indeed, he combined so much profound knowledge with a plain, pleasing, and popular mode of dealing with the geology and phenomena of volcanoes, geysers, and other points of interest, illustrated by a few experiments, and an immense diagram, that he rivetted the attention of his audience to listen to details which in other hands might have proved dry and tedious.

Saturday, Aug. 21.—The papers, exclusive of reports, read yesterday, were—

IN SECTION A.—Lieut.-Colonel Strange: On the Best Forms of Numerical Figures for Scientific Instruments, and on a Proposed Mode of Engraving them. Prof. Gustav Magnus: On the Absorption, Emission, and Reflection of Heat Prof. W. J. Macquorn Rankine: Summary of the Thermodynamic Theory of Waves of Finite Longitudinal Disturbance. Rev. Dr. Robinson: On the Appearance of the Nebula in Argo, as seen in the Great Melbourne Telescope. Rev. R. Main: Remarks on the British Association Catalogue of Stars. Rev. R. Main: On the Longitude of the Radcliffe Observatory, Oxford, as deduced from Meridional Observations of the Moon, made at Greenwich and Oxford in the Years 1864-8. Rev. R. Main: On the Discordance usually Observed between the Results of Direct and Reflexion Observations of North Polar Distance. Prof. P. G. Tait: On Comets. J. P. Gassiot: On Metallic Deposits in Vacuum Tubes. Rev. Prof. Jellett: On a Method by which the Formation of certain Chemical Compounds may be Optically E-tablished.

SECTION B.—F. Braby: On Extraction of Ammonia from Gas Liquor. Stevenson Macadam: On the Economic Distillation of Gas from Cannel Coal. Walter Weldon: On the Manufacture of Chlorine by means of Perpetually Regenerated Manganite of Calcium. T. D. Phipson: On some new substances extracted from the Walnut. T. L. Phipson: On the solubility of Lead and Copper in Pure and Impure Water. W. J. Russell: On the Measurement of Gases as a Branch of Volumetric Analysis. C. Tomlinson: On the supposed Action of Light on Combustion. Crace-Calvert: On the amount of Soluble and Insoluble Phosphates in Wheat Seed. H. Sorby: On Jargonia.

SECTION C.—H. H. Howorth: On the Extinction of Mammoth. W. Pengelly: On the alleged occurrence of *Hippopotamus Major* and *Machairodus latidens* in Kent's Cavern. W. H. Bailey: Report of the Committee on the Fossils of Kiltorcan, county Kilkenny. C. Moore: On a a Specimen of Teleosaurus from the Upper Lias. G. Maw: On the Trappean Conglomerates of Middletown Hill, Montgomeryshire. J. Thomson: On Teeth and Dermal Structure associated with Ctenacanthus. W. Carruthers: On Reptilian Eggs from Secondary Strata. W. Carruthers: On "Slickensides." Pierre de Tchihatchef: Paleontologie de l'Asie Mineure. H. Woodward: On the occurrence of Stylonurus in the Cornstone of Hereford. H. Woodward: On the discovery of a large Myriapod of the genus *Euphoberia* in the Coal Measures of Kilmaurs.

SECTION D.—Prof. Dickson: To exhibit a specimen of *Primula sinensis*, in which short styles are accompanied by short stamens. W. Carruthers, F.L.S.: Report on the Fossil Flora of Britain. Rev. A. M. Norman, F.L.S.: Letters from Prof. Wyville Thomson on the Successful Dredging of H.M.S. Porpupine in 2435 fathoms. Archdeacon Freeman: Man and the Animals, being a Counter Theory to Mr. Darwin's as to the Origin of Species. Rev. F. O. Morris: The Difficulties of Darwinism.

SECTION E.—Sir Bartle Frere, K.C.B.: On the Runn of Cutch. M. de Khanikof: Sur la Latitude de Samarcand. M. Pierre de Tchihatchef: Central Asia. George Peacock, F.R.G.S.: Encroachment of the Sea on Exmouth Warren. Dr. G. Oppert: On the Kitai and Kara Kitai. Capt. C. Dodd: Notes on the Runn of Cutch.

SECTION F.—Dr. Farr: On International Coinage. W. H. U. Sankey: On Weights and Measures. Prof. Leone Levi: On the Economic Condition of the Agricultural Labourer in England. Prof. Leone Levi: On Agricultural Economics and Wages. Frederick Purdy: Statistical Notes on Mr. J. B. Lawes's Agricultural Experiments.

SECTION G.—F. J. Bramwell: On the Laws Determining the Fracture of Materials when Sudden Changes of Thickness take place. J. F. Bateman, F.R.S.: On the Channel Railway. Admiral Sir Edward Belcher, K.C.B., F.R.S.: On a Navigable Floating Dock.

The Biological Section B is far from showing itself to be a happy adjunct to the scientific sections of the British Association. What are we to think of its gravely listening to and discussing a communication in which the author anatomatises a cherubim, and jumbles together as one authority matters from Genesis, Ezekiel, and Revelations? The sooner such dissertations and disputations are brought before the Executive Committee the better, as being not only irrelevant, but highly dangerous to the welfare of such a useful institution as the Association has hitherto proved itself to be. The number of members and associates now amounts to 1891: at Norwich they exceeded 2000, a difference which is to be attributed to local circumstances.

The divine services at the cathedral, churches, and chapels were all crowded, and the day, as usual, most propitious—a clear, bright, sunny day, yet cool and pleasant in the shade, and breezy on the heights. The Rev. Dr. Pritchard preached in the evening at St. Mary Major's to a crowded audience, his being a discourse specially intended for members of the Association, and, therefore, largely imbued with observations and sentiments having scientific references; his sermon, therefore, was duly appreciated—the reverend and learned gentleman happily combining theological and philosophical learning with the plainest religious and moral sentiments and advice, addressed to his hearers with pathos and energy. Easy as this course may appear in such able hands, it is rarely attempted with success by men of less abundant scientific knowledge.

Monday, Aug. 23.—Saturday evening was occupied with a lecture by Prof. Miller, on the Spectrum Analysis, addressed specially to the working classes in Exeter. Tickets were eagerly sought, and all early taken up, consequently the Victoria Hall was crowded to excess, great numbers of the audience being compelled to stand. Among the celebrities on the platform was Miss Burdett Coutts, whose presence becoming known, a working man arose from the body of the meeting to propose three cheers, which were heartily given, followed by three more in response to a further call for such a demonstration of respect. Miss Coutts rose from her seat, courtesied most gracefully, and reseated herself, no doubt equally surprised and gratified by the compliment so spontaneously and earnestly paid to her in acknowledgment of her munificent public gifts and estimable character. The lecture, although consisting of a series of experimental illustrations of so obstruse a subject as modes of determining the composition of the sun, and other heavenly bodies, was, nevertheless, made so clear and interesting in the treatment of it that it was listened to with marked attention by the vast audience, numbering at least 2000 persons.

The Excursions to Plymouth and other places made Exeter and the few Sections that met very bare of members of the Association; and the return of tourists was delayed to as late an hour as 12 o'clock at night. Dilettanti warfare and naval tactics at Plymouth caused mingled amusement and alarm. Rockets would not always obey orders, and even torpedoes were seen to refuse most stubbornly to explode; and then boats acquired the habit of steering right instead of left, and *vice versa*, so that visitors were somewhat perplexed to account for such extraordinary manœuvering; but all agreed that there must be some difference between playing at war and a real engagement, otherwise the general result would have been calculated to create misgivings in respect to the ability of an important portion of our naval service.

Only three sections met on Saturday, and the papers read, exclusive of reports, were as follows:—

IN SECTION A.—E. Vivian: On a New Mean Self-Registering Hygrometer. Prof. Sylvester: On Prof. Christian Wiener's Stereoscopic Representation of the Cubic Eikosi-heptagram. W. K. Clifford: On the Umbilici of Anallagmatic Surfaces. W. K. Clifford: On the Theory of Distance. R. B. Hayward: Sketch of a proof of Lagrange's Equations of Motion referred to generalised co-ordinates. F. W. Newman: On Conic Osculation. F. W. Newman: On Surfaces of the Second Degree. F. W. Newman: On Curves of the Third Degree. M. Collins: On the Common Tangents of Circles.

SECTION C.—J. Randall: On the Denudation of the Shropshire and Staffordshire Coal Field. (Communicated by W. W. Smyth.) C. Le Neve Foster: On the Occurrence of the Mineral Scheelite at Val Toppa Gold Mine, near Domodossola, Piedmont. J. E. Taylor: On certain Phenomena in the Drift, near Norwich. J. E. Taylor: The Water bearing Strata in the Neighbourhood of Norwich. G. A. Lebour: Denudation of Western Brittany. (Communicated by R. A. C. Godwin-Austen). G. A. Lebour: Notes on some Granite of Lower Brittany. H. A. Nicholson: On some New Forms of Graptolites. (Communicated by the President.)

SECTION F.—James Heywood, M.A., F.R.S.: On the Examination Subjects for admission into the College for Women at Hitchen. Rev. W. Tuckwell, M.A.: On the Method of Teaching Physical Science. Jesse Collings: Some Statistics of the National Educational League. Raphael Brandon: Some Statistics of Railways in their Relation to the Public. James Stark, M.D.: Contributions to Vital Statistics. P. M. Tait: Vital Statistics of Bombay. Robert Main: On Naval Finance. Hyde Clarke, F.S.S.: On the Want of Statistics on the Question of Mixed Races. Hyde Clarke, F.S.S.: On the Rapidity of Human Thought. Hyde Clarke, F.S.S.: On the Distinction between Rent and Land Tax in India.

Tuesday, Aug. 24.—The following is a list of the papers read yesterday in the several sections, omitting such as were only committee reports.

SECTION A.—Dr. Neumayer: Recent Fall of an Aërolite at Krähenburg. J. Glaisher: Results of Experiments with a Captive Balloon. Dr. R. J. Mann: On the Rainfall in Natal. Dr. Hudson: On the Formation of Dew. A. E. Fletcher: On a New Anemometer. F. J. Mott: On the Maury Barometer. — Warner: On Chambered Spirit Levels.

SECTION B.—S. Williams: On the Action of Phosphoric Chloride on Hydric Sulphate. J. Dewar and G. Cranston: On some Reactions of Chloro-Sulphuric Acid. A. Matthiessen and C. R. Wright: On the Action of Hydrochloric Acid on Morphia and Codeia. Dr. Andrews: On the Absorption Bands of Bile. M. Janssen: Methode Spectrale pour la Recherche des Composés du Sodium. M. Janssen: Sur la Spectre de la Vapeur d'Eau. W. C. Roberts: On a Specimen of Obsidian from Java. W. D. Michell: Are Flint Instruments of the First Stone Age found in the Drift?

SECTION C.—H. Brady: Notes on Mr. Moore's Foraminifera from Mineral Veins. C. W. Peach: Notice of the Discovery of Organic Remains in the Rocks between the Nare Head and Porthalla Cove, Cornwall. R. Brown: On the Elevation and Depression of the Coast of Greenland. G. Maw: On Insect Remains and Shells from the Lower Bagshot Leaf-bed of Studland Bay, Dorsetshire. J. Thomson: On New Forms of Pteroplax and other Carboniferous Labyrynthodonts, and of Megalichthys; with notes on their Structure, by Dr. Young. Dr. Hicks: On the Discovery of Fossil Plants in the Cambrian Rocks (Upper Longmynds), near St. Davids. Dr. Mann: On the Gold of Natal. L. C. Miall: Experiments in Illustration of the Contortion of Rocks.

SECTION D.—Sir John Lubbock, Bart.: On the Primitive Condition of Man, being some remarks in answer to the "Speculations" of the Duke of Argyll. Dr. P. M. Duncan: On the Age of the Human Remains in the Cave of Cro-Magnon, in the Valley of the Vezere. Col. Lane Fox: Flint Implements of Palæolithic Age from the Gravels of Ealing and Acton. Rev. E. N. Dumbleton: Discovery of a Crannog in South Wales. Rev. Dr. A. Hume: On the so-called "Petrified Human Eyes" from the graves at Arica, Peru.

SECTION E.—Admiral Sir E. Belcher: On the Distribution of Heat on the Sea Surface throughout the Globe. A. G. Findlay: On the Supposed Influence of the Gulf Stream on the Climate of N.W. Europe. Capt. R. V. Hamilton, R.N.: On the Best Route to the North Pole. F. F. Searle: The Upper Amazons. R. Edmonds: On the Extraordinary Agitations of the Sea. T. Wyatt Reid: Influence of Atmospheric Pressure on the Displacement of the Ocean.

SECTION F.—Frederick Purdy: On the Pressure of Taxation on Real Property. Dr. W. Neilson Hancock: On Local Taxation in Ireland. W. Botley: On the Condition of the Agricultural Labourer.

SECTION G.—Four lengthy but important committees' reports were followed by:—T. Login: On Roads and Railways in Northern India, as affected by the Abrading and Transporting Power of Water. Joseph Whitworth, LL.D., F.R.S.: On the Penetration of Armour Plates by Shells with Heavy Bursting Charges, Fired Obliquely. Lavington E. Fletcher: On Government Action with regard to Boiler Explosions.

At 3 o'clock, yesterday, there was a full and animated meeting of the General Committee, when deputations from Edinburgh, Liverpool, Plymouth, Brighton, and Belfast addressed the meeting, pressing their several claims with warmth and vigour, and no small display of pleasantry. The President of the Association presided, and after taking the votes, declared the election in favour of the next meeting being at Liverpool, amidst continued cheering, the majority of votes only amounting to 5, when taken, between the numbers for Liverpool and Edinburgh. The meeting next proceeded to elect the President of the Association for next year, when, on Professor Huxley being proposed and seconded, he was unanimously elected with much applause, in which, perhaps, a little more than usual warmth was expressed from some observations having arisen to the effect that the course adopted was a variation from the original mode of election, which sought in a President some nobleman or distinguished individual in the county where the Association designed to hold its meetings.

In the evening Mr. Lockyer gave his lecture in the Museum to a crowded audience, the subject being principally an exposition of his own discoveries in Spectrum Analysis, illustrated by numerous large diagrams and instruments. He was continuously and deservedly applauded throughout its delivery, which, as a young and enthusiastic physicist, must have been highly gratifying to him.

The continued fine weather, the activity of the several sections, and variety of employment kept all the members in a state of excitement. From the first day Exeter itself has made a wonderful display of colours and flags of all sizes and forms, some pendant from windows, others on lines crossing the streets, or raised above the roofs on poles. In the main thoroughfares, High-street and Fore-street, there are no less than 142, and throughout the city small and large streets vie with each other in the variety of their banners. But there has been less feasting at Exeter than at any recent meetings, falling far short of Dundee, Nottingham, or Norwich in this respect.

Wednesday, Aug. 25.—Yesterday the following papers were read:—

IN SECTION A.—J. Whitworth, F.R.S.: On the Penetration of Armour-Plates by Shells with heavy bursting charges fired obliquely. M. Janssen: Sur une Méthode pour Obtenir les Images Monochromatiques des Corps Lumineaux. M. Janssen: Faits Divers de Physique Terrestre. Prof. A. Morren: On the Chemical Re-action of Light, discovered by Prof. Tyndall. H. Hudson: On the Formation of Dew. G. Johnstone Stoney: On the Numerical Relations between the Wave-lengths of the Hydrogen Rays. G. Johnstone Stoney: On a Convenient and cheap Heliostat. C. Brooke: On the Influence of Annealing on Crystalline Structure. W. H. L. Russell: On the Mechanical Tracing of Curves. Prof. Sylvester: On the Successive Involutes to a Circle. Hon. J. W. Strutt: On an Electromagnetic Experiment.

IN SECTION B.—E. C. C. Stanford: A Chemical Method of Treating the Excreta of Towns. H. Bamber: On the Water Supplies to Plymouth, Devonport, and Exeter. P. Spence: On the Production of Higher Temperatures by Steam of 212° Fahr. A. Oppenheim: On Bromo-Iodide of Mercury. A. Oppenheim: On Benzoe-sulphuric Acid. Prof. Jellett: On a Method of Determining with Accuracy the Ratio of the Rotating Power of Cane Sugar and Inverted Sugar. Dr. Fritzsche: Notes on Structural Change in Block Tin. (Communicated by W. R. Roberts.) H. Cooke: On the Registration of Atmospheric Ozone in the Bombay Presidency, and the Chief Causes which Influence its Appreciable Amount in the atmosphere. J. Lowthian Bell: On the Decomposition of Carbonic Oxide by Spongy Iron.

IN SECTION C, exclusive of reports.—R. Etheridge: On the Occurrence of a Large Deposit of Terra Cotta Clay at Watcombe, Torquay. Rev. J. D. La Touche: An Estimate of the Quantity of Sedimentary Deposits in the River Onny. J. L. Lobley: On the Distribution of the British Fossil Lamellibranchiata. Rev. J. D. La Touche: On Spheroidal Structure in Silurian Rocks. N. Whitley: On the Distribution of Shattered Chalk Flints and Flakes in Devon and Cornwall. Prof. Tennant: Diamonds received from the Cape of Good Hope during the last year. J. Jeffreys: On the Action upon Earthy Minerals and Compounds, of Water in the form of Heated Steam, urged by Wood Fuel, &c. J. W. Reid: On the Physical Causes which have produced the unequal distribution of Land and Water between the Hemispheres. C. Jecks: On the Craig Formation. J. E. Lee: Notice of remarkable Glacial Striæ, lately exposed at Portmadoc. E. A. Conwell: On a Fossil Mussel Shell found in "drift" in Ireland.

IN SECTION D.—M. T. Blanford: On the Relations of the Fauna of British India to that of the Ethiopian and so-called Indian Regions. Robert Brown, F.R.G.S.: The Mammalian Fauna of North West America. H. Woodward, F.G.S.: On a New Isopod from Flinder's Island. Ralph Tate, F.G.S.: On the Land and Fresh-water Shells of Nicaragua, Central America. W. F. Webb: Five Years Experience in Artificial Fish-breeding, showing in what Waters Trout will and will not Thrive, with some Remarks on Fish and our British Fisheries. Frank Buckland: On the Salmon Rivers of Devon and Cornwall, and how to Improve them. Prof. E. Perceval Wright: On Rhinodon Typicus, the largest known Shark. Dr. Scott: On a Hybrid, or other Variety of Perdix Cinerea, found in Devonshire. Miss Lydia Becker: On Alteration in the Structure of Lychnis Dioica, observed in Connection with the Development of a Parasitic Fungus. A. Hancock, F.L.S., and Thomas Atthey: On some Curious Fossil Fungi, from the Black Shale of the Northumberland Coal Fields. Admiral Sir E. Belcher: Stone Implements from Rangoon. Sir Duncan Gibb, Bart.: Paucity of Aboriginal Monuments in Canada. W. C. Dendy: On the Primeval Status of Man. A. L. Lewis: Notes on the Builders and the Purposes of Megalithic Monuments. H. H. Howorth: Westerly Drifting of the Nomades from the Fifth to the Nineteenth Century. J. Bonwick: Origin of the Tasmanians. K. Bridgman: Voltaic Electricity in Relation to Physiology. Prof. Cleland: On the Interpretation of the Limbs and the Lower Jaw. Dr. Richardson, F.R.S.: Report on the Physiological Action of Chloral. Dr. Burdon Sanderson, F.R.S.: To Exhibit an Instrument for Recording Respiratory Movements. H. Blanc, M.D.: Human Vaccine Lymph and Heifer Lymph Compared. J. C. Galton, M.A., F.L.S.: The Myology of Cyclothurus Didactylus. Prof. Cleland: On the Human Peritoneum, Illustrated by that of the Wombat. Dr. Heaton: Further Observations on Dendroidal Forms assumed by Minerals.

IN SECTION E.—Trelawney Saunders: Cooper's Attempt to Cross from China to India. Douglas Forsyth: Trade Routes between Northern India and Central Asia. Trelawney Saunders: The Himalayas and Central Asia. Dr. G. Neumayer: Scheme for a Scientific Exploration of Australia. W. P. Blanford: Northern Abyssinia. Dr. Birdwood: On the Geography of the Frankincense Plant. Dr. C. Le Neve Foster: On Raleigh's El Dorado.

IN SECTION F.—Dr. Robert Mann: On Assisted Emigration. Archibald Hamilton: The Economic Progress of New Zealand. James Heywood: On Municipal Government for Canadian Indian Reserves. Sir J. Bowring: On Prison Laws as Associated with Prison Discipline. F. P. Fellowes: On our National Accounts. Sir J. Bowring: The Devonshire Association for the Advancement of Science and Art.

SECTION G.—Thomas D. Barry: On the Utilisation of Town Sewage. Latimer Clark: On the Birmingham Wire Gauge. S. A. Varley: On a New System of Communication between Guards and Passengers on Railways. G. J. Symons and Rogers Field: On a Method of Determining the True Amount of Evaporation from a Water Surface. R. E. Froude: The Hydraulic Internal Scraping of the Torquay Water Main. W. Froude: Some Difficulties in the received Views of Fluid Friction. Prof. T. C. Archer: Description of a New System of House Ventilation, by J. D. Morrison, of Edinburgh. W. Smith, C.E.: An Improved Vertical Annular High-Pressure Steam-Boiler. J. T. Chillingworth: An Air Engine.

The second *soirée* that occurs during the week of meeting took place yesterday evening in the Albert Museum, where the attractions were numerous, including art, antiquities, microscopes, electrical experiments, and other scientific attractions. The only drawback was for a *soir de* to be broken up into four or five sections, instead of the company promenading leisurely over one floor, to be seen at one view; the going up stairs and dividing into passages and separate rooms sadly interfered with the general effect. The company, however, was most brilliant, and although Liverpool (the next place of meeting) may boast of its witches, Exeter is far from being deficient in a display of female charms.

This being the last day of meeting, the only Sections that assembled and read papers were:—

SECTION A.—T. Bruce Warren: On Electrification. F. H. Varley: On the Electrical Balance. G. Johnstone Stoney: On Collimators for Adjusting Newtonian Telescopes. G. J. Symons: To Exhibit a Storm Rain Gauge. Balfour Stewart; On Meteorological Reductions, with Especial Reference to the Element of Vapour. Balfour Stewart: On a Self-Recording Rain Gauge. W. Huggins: On the Heat of the Stars.

SECTION D.—Dr. Maxwell T. Masters: Relative Value of the Characters Employed in the Classification of Plants. Dr. Birdwood: On the Genus Boswellia, with Descriptions and Drawings of Three New Species. W. Pengelly: Whale Remains washed ashore at Babbicombe, South Devon. G. Gladstone, F.C.S.: Observations on Infusoria at Münster am Stein, Creuznach. C. S. Wake: Initial Life. Dr. Richard King: On the Natives of Vancouver's Island. W. S. Hall: The Esquimaux Considered in their Relationship to Man's Antiquity: Drs. R. S. Charnock and C. C. Blake: Notes on the Woolwa and Mosquito Vocabularies. F. Drake: Human Remains in the Gravels of Leicestershire. T. M. Hall: Method of Forming Flint Flakes used by the Early Inhabitants of Devon. R. Tate: Notes on an Inscribed Rock. Sir D. Gibb, Bart.: An Obstacle to European Longevity beyond Seventy Years. Sir D. Gibb, Bart.: A Cause of Diminished Longevity among the Jews. R. Garner: On the Brain of a Negro. H. H. Howorth: Frontier Line of Ethnology and Geology. F. H. Kinahan: Race Elements of the Irish people. C. S. Wake: Race Affinities of the Madecasses. J. Stirling: Races of Morocco. R. Garner: On the Homologies in the Extremities of the Horse. Prof. Crum Brown: On the Connection between Chemical Composition and Physiological Activity. Dr. Kidd: On Sleep and Anesthetics.

SECTION F.—Henry Dircks, C.E., LL.D.—Statistics of Invention, illustrating the Policy of a Patent Law, which, being the only communication before the Section, led to a most animated and interesting discussion, occupying two hours.

A meeting of the General Committee at one o'clock, and the concluding meeting at half past two o'clock, in the Victoria Hall, closed the meeting for the present session.

The Mayor of Exeter having sent cards of invitation to about 300 distinguished members of the Association to partake of luncheon at four o'clock, at the Royal Public Rooms, there was a full attendance, and excellent accommodation was provided. It is almost needless to say that the entertainment was in every respect of the most recherche character affording undivided commendation. Thus ends the meeting at Exeter, after a week of unprecedented fine weather at the present season of the year.

GAS MANUFACTURE—UTILISATION OF WASTE PRODUCTS.

By FREDERICK BRABY, F.G.S., Mount Henley, Sydenham Hill.

"A new and economical method for effecting the extrication and condensation of ammonia from gas liquor for purposes of cheap carriage, and for facilitating the manufacture of ammoniacal salts." It is but a few years since that the various bye products obtained from the manufacture of coal gas were not merely a drug in the market, but proved an absolute nuisance to the manufacturer and to the general public. Coal tar was even burnt under the retorts, or was introduced therein for the production of gas, and gas liquor was commonly given away to anyone whose ingenuity might enable him to turn it to a useful purpose. But the progress of science in this, as in other cases, soon discovered applications were none were supposed to exist, and enormous sums have already been realised by the conversion of what were once useless and refuse products into materials of use, and of high commercial value. From coal tar are not only now obtained naptha, benzole, carbolic acid, and other valuable derivations, but also the brilliant and diversified colours of the so-called aniline dyes are obtained from the same source. The ammoniacal liquor, too, to which special and particular attention is directed by this paper, is now not only not

given away in the metropolitan and other districts, but in certain localities the greatest competition exists for its purchase. It at present constitutes in this country the principal source of ammonia, and, consequently, of the ammoniacal salts, which are so usefully and so successfully applied in the arts, and more especially to agriculture. In London and its neighbourhood the purchase of the residuary products of the various gas companies is eagerly sought after, and it is now considered a privilege to be allowed permission to tender for them for the term of one, two, or more years' supply. Practically, the tar and gas liquor trade is in the hands of a few parties, jealously desiring to exclude outsiders, who thus find it extremely difficult, and often absolutely impossible, to obtain even a few thousand gallons.

The object of this paper is to show how the demand for gas liquor, which far exceeds the means of actual supply, can be met. It is to prove, moreover, how by condensation and reduction of bulk for transport small and remote gas works may be enabled to utilise and export their residual products at a profit; and how, above all, the existing supply of ammonia, as produced and utilised from the manufacture of gas, may, by the introduction of these and other improvements, be practically increased in quantity from 10 to 50 fold. The strength of gas liquor is commonly specified in the various tenders as technically 6 ozs. The prefix, denoting the number of ounces, refers to each gallon of the liquor, and does not signify the number of ounces of ammonia that are present, but the number of ounces of sulphuric acid which would be required to neutralise the ammonia. The liquor is commonly sold by the butt of 108 gallons, consequently a butt of 6-oz. liquor implies, by calculation that 108 times 6 ozs., or 40 lbs. of sulphuric acid, are required to saturate the whole quantity. Now, it is found in practice that if we divide the quantity of sulphuric acid required by three we shall get at the quantity of ammonia actually present. This result closely agrees with theory, the equivalent of dry ammonia being 17, and that of monohydrated sulphuric acid (oil of vitrol) being 49, which is very nearly in the proportion of one to three; it follows, therefore, that as 40 lbs. of sulphuric acid are required to saturate a butt of 6-oz. liquor, so one-third of this, or little more than 13 lbs. of real ammonia, are contained in this immense quantity of liquid and merchantable product, weighing, as it does in the aggregate, no less than 1107 lbs., or nearly ½ ton. Or, referring to the ordinary commercial standard—of 6 oz. to the gallon—6 ozs. of sulphuric acid divided by three gives 2 oz. of ammonia as the entire quantity present. Now, a gallon of the gas liquor weighs 10 lbs., and if the pounds be multiplied by 16, to reduce them to ounces, we have a total of 160 ozs., containing only 2 ozs. of real ammonia, or 1 oz. to 80 ozs. of water. The result of this is practically to prohibit the transport of gas liquor over any but moderate distances, because in its present form for every ton of real ammonia carried by barge, tank, cart, or otherwise no less than 80 tons of water must be carried for no other purpose but as a solvent. It must not be inferred, however, that the *whole* of these 80 tons of water is waste carriage. Ammonia in a free state cannot be conveniently carried, except when dissolved in a certain quantity of water. It would not be judicious to concentrate ammonia to a higher degree than an 0·900, since if in course of carriage it were subjected to any great degree of heat the water at an elevated temperature would disengage some of the ammonia held in solution, and such a disengagement of ammonia might be attended with dangerous results. A very useful and safe solution for all purposes of transit would be about one part by weight of ammonia to four parts of water; this would reduce the present cost of carriage for this important article to no less than 20 times; or, in other words, the transit of a certain quantity of ammonia over a certain distance, now costing 20*l.*, would, if conveyed in the above concentrated form, be reduced to 20*s.* This scale of reduction would at once enable it to be carried by rail in petroleum or other barrels, or in tank trucks, or otherwise, and would bring the various and almost innumerable gas works which are scattered over the United Kingdom within economical transport of the centres of manufacturing industry, so that this important bye-product of gas making might be utilised for the general good, and be not so extensively wasted as has been, and is now, too more frequently the case.

In order to effect this desirable object, Mr. Braby recently, in conjunction with Mr. Isham Baggs, secured a patent for effecting the necessary concentration of ammonia by certain novel means, which promise, in practice, to prove far more rapid and economical than any hitherto employed. The process may be shortly described as follows:—To the common ammoniacal gas liquor, as now produced at the gas works, a certain quantity of slaked lime is added. The liquor thus treated is placed in a capacious boiler or still, containing from 4000 to 5000 gallons; the whole is then heated, and maintained at a temperature of from 100° to 200° Fahrenheit, the liquor being slowly but constantly stirred by means of an internal agitator, the spindle of which passes through a stuffing box in the end of the boiler. A powerful blast of air from a double-action force-pump, actuated by a small steam-engine or otherwise, is blown continuously through the liquor. The air enters by two long perforated pipes, placed near the bottom of the boiler, and in its upward passage it is compelled to pass through a horizontal diaphragm, drilled with numerous small holes. The result of this arrangement being that the air, in its ascent, is subdivided into innumerable small sheaves and bubbles, to each and all of which, in accordance with well known and recognised laws, the ammonia attaches itself, and is carried away with only a very small proportion of aqueous vapour. An exit-pipe is fixed to the top of the boiler, so as to convey the mixture of air and ammonia, and the extremity of this pipe dips into a supply of water contained in a cold and suitable receiver, where the ammonia is immediately absorbed, and the air, after thus effecting its removal in a separate state, escapes through the water, and is permitted to pass off into the atmosphere. The condensers are generally arranged like a series of what are known as Woulfe's bottles; but for the purpose of obtaining great strength and purity this arrangement may be superseded in the following manner:—The ammoniacal gas separated by the air is purified in a manner which will be afterwards described, and is then caused to pass into a vessel about three parts filled with broken lumps of pure block ice. From the well-known affinity of ammoniacal gas for cold water, the gas is arrested by the ice, which is rapidly liquified, and a pure solution of ammonia of any required strength is easily obtained. It is advantageous to cool down the mixture of air and ammoniacal gas before it is allowed to enter the condenser; the air, after having parted with the ammonia which has been dissolved by the liquified ice, passes off into the atmosphere, as in the former instance. The finest Norwegian transparent block ice may, in the height of summer, be obtained at the London Docks at 23*s.* per ton, and even less, according to the number of tons required, the supply being constantly maintained by the arrival of fresh ships. Or ice may be obtained by one of Siebe's refrigerating machines almost as cheaply as that which is imported. This patent process for separating the ammonia, by blowing air through gas liquor, when at an elevated temperature, is so much more rapid in its operation than the process of merely boiling the gas liquor, as hitherto conducted, that with a very moderate-sized apparatus several thousand gallons of gas liquor can be heated in a single day, and the ammoniacal produce of the largest works may be continuously converted into a concentrated and more portable form, without trouble or delay. Even in the smallest works, consuming not more than from 10 to 50 tons of coal a week, the bulk and weight of the gas liquor may be quickly reduced under this patent, and the result will be of such standard value that a still, containing from 20 to 100 gallons, would, probably, in such cases, answer every desired purpose, and would be found to be remunerative. In many instances the gas liquor might be heated, and the power supplied, if desirable, from the waste heat of the retorts. By the adoption of this improved process the present trade in crude ammonia may be expected to expand, and to become of higher importance than it now is. The comparatively limited supply which is now available restricts its application. The commercial advantages which would be derived from the many technical purposes to which it is applicable would be considerable, and manufacturers being enabled to obtain cheap supplies from distant sources, the total quantity utilised would be immensely increased.

When, instead of producing caustic ammonia, it is desired to manufacture ammoniacal salts, the ammoniacal gas, in conjunction with the atmospheric air, may be conducted into sulphuric or muriatic acid, or into a metallic or saline solution capable of appropriating the ammonia. As the evaporative power of air increases with the absence of moisture therein, it is possible that by drying the same artificially, before introducing it into the liquour, it would take up a greater quantity of ammonia. The removal of all moisture from air may be effected with comparatively little expense by the suction of the air required for the force-pump through sulphuric acid and a close wooden box containing lumps of chalk. This method is well known in connection with other applications. The blast of air may be hot or cold, and may be delivered in any manner adapted to increase and effect more intimate contact between the air and the liquid containing the ammonia. By adopting the atmospheric or blowing principle, nearly the whole of the ammonia can be liberated from the solution in which it is contained, without any fire or external heat applied to or under the still or boiler; but if the liquor be heated, the solubility of the alkaline gas is diminished, and its extraction is facilitated. Gas liquor is, in this country, the most common and, at the same time, the most economical source of ammonia; and the system of extraction by forcing air would, of course, be equally applicable to ammoniacal bone liquor, or to any other chemical preparation in which the caustic ammonia is held in solution.

The principles already indicated may, perhaps, be illustrated with advantage by a brief description of a working plant actually constructed at Deptford for the purpose of extracting ammonia. An excavation has been made, in which is sunk a reservoir for containing the gas liquor, and having the following dimensions—35 ft. long, 7 ft. wide, and 6 ft. deep. The bottom is formed of 1 ft. of concrete, two courses of bricks, and of two courses of red flat tiles; the sides are of 14-in. brickwork, two courses with tiles, in conjunction with concrete. The wrought-iron still is set in brickwork, so that flame may play more than half round its external surface. It is 30 ft. long by 6 ft. in diameter. About 4000 gallons of gas liquid are pumped into it from the reservoir for the purpose of being operated upon. Heat is applied by means of a fire underneath, but a coil of hot air or steam pipes placed in the interior of the still or boiler would be equally efficacious. Two cast-iron air-pipes, which are attached to the ammonia-generator, extend along its whole length—30 ft.—and are situated one on either side, and nearly at the bottom. They are 3 in. in diameter, and are perforated with holes increasing in size as they extend from the inlet. Into these pipes, and from thence into the gas liquor, is driven atmospheric air by means of a pair of cast-iron force-pumps. These are 20 in. in diameter, 1 ft. 8 in. stroke, with rods and slings, wrought-iron connecting-rod, and crank, and a cast-iron beam 6 ft. long. On the entry of the streams of air they are caught and agitated by the 12 iron fans of a stirrer, making about 80 revolutions per minute. The air, together with the lime and the various constituents of the gas liquor—viz., water, ammonia, carbonic dioxide, sulphuretted hydrogen, sulphocyanides, &c.—are thus brought continuously into intimate contact. The air loaded with the volatile alkali, which has become eliminated from the solution, passes upwards into the steam-chest, and through a branch pipe into the purifier or washer. This is a small wooden vessel of the capacity of 350 gallons, containing lime, and being about one-third full of water. It has a tight head, and a stout perforated elm false bottom, the holes being concentric, and increasing in number and dimension as they radiate from the inlet, which is brought below the false bottom. This purifying vessel is furnished with a small agitator, having two blades, one revolving above and the other below the false bottom. There are two trial or test taps at appropriate heights, to test for gas or for water, and there is also a pipe sealed at one end rather less than half way from the bottom, for the purpose of leading away any excess of liquid that may accumulate owing to the condensation of aqueous vapour which may pass over with the volatile alkali. There is a long straight tube, or safety-pipe, from the washer, and the bent pipe from the ammonia generator is also provided with a safety-valve and a vacuum-valve. In the washer the ammonia is deprived of any remaining hydrosulphuric acid or other impurity that may have escaped being fixed in the generator. About half a bushel of finely sifted slacked chalklime is found to be a suitable charge for the washer, and when this becomes saturated or impure it is removed by means of a pipe and tap placed at the bottom of the vessel. The washer being a close vessel soon becomes full of air and gas, which are forced by the pressure through a pipe opening into the top, and leading to a coil, or worm, placed in a cold-water cistern, and terminating in a deep close vessel about one-third full of pure cold water, which has been condensed from the waste steam from the engine. A portion of the ammonia becomes absorbed by the water, but the residue, together with all the air, after bubbling up through the liquid, is conducted by a bent pipe to nearly the bottom of a second similar receiver, and thence in the same way to a third, but which is opened at the top. The air, having fulfilled its function, is now permitted to escape into the atmosphere, the whole of the ammonia having, however, been arrested. This last receiver, instead of water, contains a strong solution of chloride of iron, which, being denser, and possessing a higher specific gravity than water, offers a greater pressure and resistance to the passage of the gas. The iron salt is, of course, decomposed with formation of muriate of ammonia in solution with deposition of a green mud, containing sesquioxide of iron, which, after having been calcined, is found to constitute an excellent pigment for rough iron or wood work.

After the whole of the ammonia has been extracted from the gas liquor the contents of the still are run off into a draining pit, from which the clear solution finds its way into the sewers, and the solid inodorous lime compounds may be carted away. This draining pit is constructed of 1½-inch deal boards, together with sand and brickwork; it is 4 ft. 9 in. wide, 5 ft. 4 in. deep, and 10 ft. long; there are fillets whereon to rest three perforated shelves or platforms; the bottom is formed of perforated deals, with 6 in. of sand, also with gravel and cement. There are channels and small drain-pipes leading into a large central earthenware pipe, and from thence into the sewer. The sharp sand, &c., under the perforated boards can be removed at will and be replaced by fresh materials whenever required. Care must be taken that the large pipe from the boiler to the washer be sufficiently high to guard against any back pressure. The vacuum valve opens and admits air when the fire of the still is withdrawn, and the steam becomes condensed.

In order to ascertain the exact state of the contents of the boiler at any required height, and to avoid tapping the upper portion of the boiler at too many places, the following simple contrivance is adopted:—There is one tap at the lower end, to which is attached a short pipe inside the still, working easily on an elbow. To this pipe is connected a copper wire, having its outlet just above the external surface of the boiler, and by which wire a short pipe may have its orifice presented at any required height at which it is desired to ascertain the state of the contents of the vessel. For instance, supposing the fire to be withdrawn, and the agitators to be quiescent, if the end of the tube were pulled up by the wire, and the tap opened, a clear liquid would issue, which could be tested in order to ascertain whether the whole of the ammoniacal gas had been removed. On the other hand, if the short tube were allowed to lay along the bottom of the still the open cock would allow the green sulpho-calcareous mud to escape. It is stated in Dr. Miller's "Chemistry" that at a temperature of 32° water takes up about 1050 times its volume of ammonia; at 59°, 727 times its volume; at 78°, 586 times its volume. Water saturated with ammonia at 60° contains more than one-third of its weight of the gas, increasing in bulk from 1 to 1·5, and becoming specifically lighter. Hence the receiver should be not more than one-third or one-half full of water, to allow for the increase in bulk caused by the solution of the ammonia.

Valuable papers upon the utilisation of the waste products of the manufacture of coal gas were read in July, 1867, before the British Association of Gas Managers, by two of our first authorities on this subject—Dr. Letheby and Mr. W. Eson. Dr. Letheby declares that it is manifestly of the greatest importance that the liquor should be sent away to the gas works as strong as possible—it ought, in fact, never to be under 6° Twaddle, or of less than 12 ozs. strength, and with proper condensation and judicious washing there should be from 29 to 30 gallons of such liquor produced from every ton of coals. The price in London is 2*s.* per butt of 8 ozs., with an increase of 4*d.* per ounce on every additional oz. of acid-strength. Below 3° of Twaddle, or 5 ozs. of acid, it does not pay for working, whereas at 10° or 11° of Twaddle it is a valuable product. Both Dr. Letheby and Mr. Eson emphatically insist upon the importance of the strength of the ammoniacal liquor. So rapidly does the commercial value augment in relation to its concentration, that whereas 108 gallons of gas liquor are worth 4*s.*, the same quantity of caustic ammonia, of specific gavity 0·900°, is worth from 15*l.* to 20*l.* A lower strength of gas liquor than 6 ozs. has not hitherto been thought worth working, but one advantage in Braby's system consists in the fact that a high strength is not indispensable, as in the ordinary method of extracting ammonia, and of manufacturing ammoniacal salts, even 2 ozs. would in practice yield a profit. As an evidence of the importance of an increased supply of ammonia, and of its large demand, it may be mentioned that a firm with which the writer is connected recently offered 4*s.* per butt of 6-oz. liquor, and yet was unable to obtain a supply, showing that the value has doubled in the short space of two years. Mr. Eson describes an economical arrangement for the extraction of ammonia from gas liquor with the assistance of steam, and by an apparatus similar to a Coffey's still, but which is subject to the disadvantage that the noxious gas—sulphuretted hydrogen—is not simultaneously fixed or disposed of, and that at least 15 per cent. of ammonia is left in the liquor, which has afterwards to undergo the supplementary process of distillation with lime. The present method of making liquid ammonia is (as far as I am acquainted) from sulphate or muriate of ammonia, which is itself obtained from gas water. By means of the atmospheric process liquor ammonia may be obtained much more quickly and economically from gas liquor direct.

There are several gas works where ammoniacal salts are now manufactured, but it is suggested that in new works, or at those where the gas liquor is not at present utilised, it would be preferable, in the event of the adoption of the principle herein advocated, that the ammonia after concentration should be sent to the sulphuric or muriatic acid works, rather than that the acid should be sent to the gas works. In metallurgy, it is found more advantageous to transport the calcined or partly prepared ores to the coal districts for smelting, rather than to take the fuel to the mines. Barges fitted with tanks ordinarily employed in the conveyance of gas liquor contain from 3,000 to 8,000 gallons. A land journey of 12 miles, with two horses for a load of 500 gallons in a tank-van, now costs 1*l.* By rail the cost of freight is 1*d.* per ton per mile. The advantages of the above-described system may be summed up as affecting a considerable economy in labour, time, and occupation of plant, together with a facility of extracting the whole of the ammonia from the gas liquor in a pure condition. A manufactory previously consuming 10,000 gallons of gas liquor per week may now utilise 24,000 gallons, and at about half the expense of fuel of that formerly incurred. The subject is one of great interest in a chemical point of view, and is of high importance to the metallurgist and manufacturer, whilst the increase in value of ammonia to the farmer (with whom it is almost another name for fertility and abundance) is so great, that any process for facilitating the manufacture is worthy of the most serious consideration.

STATISTICS OF INVENTION, ILLUSTRATING THE POLICY OF A PATENT LAW.

BY HENRY DIRCKS, C.E., LL.D., ETC.

The time seems to have arrived for a closer enquiry into the policy of a Patent Law than the subject has hitherto obtained, for, in all probability, a Parliamentary Committee or Commission will be appointed next session, to take evidence in reference to the working of our present system of Patent Laws; and the matter has already been agitated by the working classes, particularly at a conference presided over by Sir Roundell Palmer, who consider their interests would be at stake should certain proposed measures be adopted, as suggested by a small, but influential, party, who denounce Patent Law as an interference with the natural rights of man, and, consequently, retarding all improvements in arts, mechanical sciences, trades, and commerce. In fact, if we are to believe all we hear, Patent Laws never had, and never can have, any other than an evil tendency, when considered in an enlightened point of view, for the benefit of mankind at large.

The questions whether Patent Laws are to be retained and reformed, or abolished, can only be satisfactorily answered by tracing historically and statistically what have been their results hitherto. In the first place, it is quite clear that heavy patent charges act on the patent system like heavy duties on commerce; excessive fees become prohibitory duties; patents fall off, and only men of ample means can afford to procure them. Hence the history of patented inventions from the period of Queen Elizabeth to that of the present reign, dating to October, 1852, is meagre in the extreme. Therefore, for no less than four hundred years Great Britain and Ireland were, if not completely, yet certainly very nearly approaching, that happy state desired by Patent Law abolitionists. The number of patents per annum was so exceedingly small that their influence on the arts and sciences and commerce of this country must have been infinitesimally small. But in what respect were manufacturers benefited? What were the great inventions of the age thus indicated? Let an answer to such queries be given after a careful investigation of the mechanical and other treasures of the Kensington Museum.

When we consider guns and gunpowder as unpatented inventions of the 13th century, it may be some consolation to opponents who see in unimproved inventions, in inventions in their infant state, all that man need desire. Or, in the same mood, to revert to block-printing, introduced by Gutenberg in the 15th century—a second splendid and unpatented invention. The waste period between is never considered, nor even the obvious stagnation of all improvement. Progress there was none—that is, as we consider progress; and yet if Patent Law abolitionists expect to find vantage ground on such wild assumptions as these and similar instances afford them, it is very evident how indefensible their arguments are when thoroughly scrutinised. The ground was then so barren that the seeds of scientific knowledge refused to germinate on its ungenial surface. It is true the elements of modern progress were not wholly unknown—not even those of the steam-engine about the middle of the 17th century; but there was a decided torpor everywhere—all was stagnation, and as to inventors and inventions, they were all equally reproached and stigmatised. In October, 1852, the present improved Patent Laws came into operation, requiring only one process to include protection throughout the United Kingdom of Great Britain and Ireland, instead of being split into three; also, reducing the patent fees, and making them payable by three instalments—namely, for three, four, and seven years, being a total of fourteen years. The result of this great change in the system of obtaining and paying for patent protection has been absolutely prodigious—so much so, indeed, that it would be impossible to point out any other than a consequent increase in the trade and commerce of the country. A good invention commands capital, and capital its usual encouragement and spread of civilisation. A man need no longer be in a state of wretchedness, want, and misery who possesses a novel, simple, and practical invention. Is he a humble working mathematical instrument maker? See how Boulton took Watt by the hand, dedicated his whole fortune to promoting the success of his steam-engine, and that, too, in the face of Smeaton's declaration that he was convinced that Watt's engine "could never be generally applied as a useful agent"—for prejudice and shortsightedness always track the path of inventive genius. Mr. Young, holding in early life a very subordinate situation in a chemical establishment, now finds himself the possessor of great wealth, returning as his net proceeds in one year the immense sum of 300,000*l.*, derived from his manufacture of paraffin oil.

It is supposed that very strong arguments for the abolition of Patent Laws are offered by the suggestions—Firstly, that the inventive faculty is innate in man, and so prolific and exciting that it must germinate under the most adverse circumstances; secondly, that although in the infant state of arts and sciences Patent Laws may have served to foster inventive talent, such is their present growth and vigour that we may safely cast away all such nursery appliances. Indeed, Mr. Macfie, M.P. for Leith, thus plainly puts the case.

Now, as regards the first statement, it is quite true so far as concerns the mere simple fact of invention, whether in literature or in science. Under every disadvantage invention will exist in some form or other, and may even slightly progress. But what kind of a crop shall we reap? Was ever any great invention brought to maturity without laborious experimental research, and without a large expenditure of capital? Next to printing, what invention has been of more utility to mankind than the steam-engine? What would be the present state of society without it? And yet if we trace its history ever so briefly we perceive from what feeble efforts its present gigantic strides have arisen, permeating every class of industrial arts, and spreading far and wide the inestimable blessings of civilised life. Now, if we look at an invention in its state of maturity it is like admiring a stupendous oak, and overlooking it once having been an acorn. To what can we trace the encouragement that has stimulated inventor after inventor to toil with mechanical and other inventions amidst all the opprobrium that prejudice can cast on him, as his being a speculator, a schemer, and a fanatic? Undoubtedly he looks forward to fame and fortune, and no process so easily secures these to him as Patent Law; not that the laws are perfect—far from it—but because any law is better than no law, and every inventor finds himself surrounded less by friends than by men ever ready to adopt his ideas, if found to be of any value, without the least compunction at leaving him to starve in adversity, as was the case of Henry Cort among wealthy ironmasters, and has been the lot of hundreds of other estimable inventors. But as statements unsupported by facts are of little value, we select the progress of that great invention the steam-engine as sufficiently illustrative of the importance of a Patent Law, merely premising that the modern term *steam-engine* is one applied to an old invention, indicative of its progressive improvements. Thus—

1.—In its primitive state we find the following inventors under the respective dates annexed to them:—

1663—Marquis of Worcester.	1683—Sir Samuel Morland.
1698—Thomas Savery, F.R.S.	

2.—As an Atmospheric Engine:—

1698—Dr. Dennis Papin.	1751—Francis Blake, F.R.S.
1705—Thomas Newcomen.	1757—Keane Fitzgerald, F.R.S.
1718—Henry Beighton, F.R.S.	1758—William Emerson.
1720—Leupold.	1759—James Brindley.
1736—Jonathan Hulls.	1762—Dr. Joseph Black.
1739—Bernard Belidor.	1765—John Smeaton, F.R.S.
1741—John Payne.	1766—John Blakey.

3.—As the Steam-Engine Proper:—

1769—James Watt, LL.D., F.R.S.

We have thus gone over a period of 106 years, and find that from the introduction of the first engine 20 years elapsed before a second one appeared, and from its date 15 years elapsed before the third and fourth were made known; a fifth follows after a lapse of 7 years, a sixth in 13 years, a seventh in 2 years, an eight in 16 years, a ninth in 3 years, a tenth in 2 years, an eleventh in 10 years, a twelfth in 6 years, and afterwards at stages varying from 1 to 3 years.

Now, such was the state of inventions as a national boon under what we may term the restrictive duties of high Patent Law fees—say 300*l.* to 400*l.* for the United Kingdom, showing only 18 inventions, all relating to one and the same object, the application of steam as a mechanical agent, spread over more than a century, when at length we arrive at the true and complete steam-engine, superseding all its predecessors. Here is nothing problematical. We all know that the Marquis of Worcester spent a fortune in bringing his water-commanding engine to a sufficiently practical bearing to have it in public use for seven years raising water at Vauxhall. Unless he had been protected, in his case by an Act of Parliament, he would never, by his example, have stimulated, as he no doubt did stimulate, many succeeding inventors to follow in his footsteps. It is singularly absurd to presume that without the slightest legal protection inventors will give to society the suggestions and arduous labours thus imposed upon them; and it is remarkable that anyone should suppose that an unworked idea is tantamount to an invention brought to a practical bearing, whereas what we see is the nature of the progress made in the development of the steam-engine is precisely that which applies to all inventions whatever; and it would not be to hold an assertion to say that the principle of the steam-engine proper might as well have been found out and in practice 50 years or more before the time of its great application by Watt had Patent Laws undergone earlier revision, and been as liberal to inventors as in our day, for at the rate of only one new engine per annum there would have been 106, instead of only 18, inventions for that long period, and in such cases number is absolutely indicative of the state of progress.

The second statement alluded to presumes that the present age of invention may be looked on as having arrived at maturity. Genius no longer requires nursing. Perhaps at no age of the world would mankind have felt disposed to believe otherwise than that the age was most polished and civilised, and yet age after age what revolutions take place. Are patent abolitionists who cherish such notions prepared to show that chemistry can make no farther advances, that mechanical science is exhausted, and that no department of industry requires aid from inventors beyond what they have already acquired; and that for the future their services will be so light and unimportant that medals, or honourable mention, or a Government reward will sufficiently compensate them for all their mental and physical labours? As, however, it is unnecessary to dwell on arguments which only prove the weakness of the cause they are intended to support, it will be to greater advantage to point out what is really wanted for proving the impolicy of a Patent Law. It is always understood and believed that patented inventions introduce new manufactures, or improvements in old manufactures; also, that they are labour-saving, or more productive than ordinary processes; and, finally, that in every instance they are so productive and economic that the public at large derive from them, either directly or indirectly, the greatest possible advantages. If the reverse of this representation can be shown, if trade or manufactures suffer, then nothing can be easier than to prove the facts historically and statistically. But one recommendation remains to be given to all patent abolitionists, who find inventions to be only ideas, and ideas for improvements the cheapest and easiest imaginable of mental processes, to turn inventors themselves, or bring up a school of inventors, so as to be enabled to supersede one patented invention after another by their free gifts of such superior inventions as shall throw all patented ones in the shade, and so obtain from society their full meed of praise for their patriotic measures and throughly practical proceedings.

A very animated discussion, occupying two hours, followed the reading of this paper.—Mr. FELLOWS took the same view as Mr. Dircks.—Rev. Dr. GUISBURGH, of Liverpool, fell in with most of Mr. Dirck's views.

Mr. BOHN, publisher, submitted that protection should be given to literature and inventions; still there should be a limit according to circumstances. He thought 42 years' protection for a book was long enough; 40 years was fair enough for protection of mechanical inventions. He thought there should be some compulsion on moderate terms with reference to the publication of patents.

The discussion was continued by Mr. Wilkinson, Mr. Weldon, Mr. Bramwell, of London, and Mr. Walter Hancock, of London.

Prof. THOROLD ROGERS took up the suggestion that a Government Commission should be appointed to distribute rewards to inventors. He could conceive nothing that could be more mischievous or immoral. Such a commission would be a simple receptacle of all the vile jobs that could be concocted. (Hear, hear.) He threw out the suggestion that some machinery should be supplied by which parties who had made the same inventions should be able to vindicate their rights, as against parties who had obtained priority of registration. The present law was partial in its operation; some inventors—Professors Phillips and Jukes to wit—getting no reward at all for great public benefits which they had conferred. (Hear, hear.)

Mr. SIEMENS thought that in all reform in this matter of Patent Laws the object should be to consider, not the inventor, but the public interest. The Patent Law was, in his opinion, very imperfectly carried out at present in reference to the grant of patents. If a Special Committee of the House of Commons would enquire into the matter, with the view of amending the Patent Laws in the public interest, great good would result to the inventor. (Hear.)

Mr. WEBSTER, Q.C., pointed out the difference between discovery and invention.—Mr. DIRCKS having replied, the discussion closed.

NEW BAMPFYLDE COPPER MINE.—The specimens of ore from this mine, exhibited in the Albert Memorial Museum, attracted considerable attention. The mine has been very judiciously and economically managed by the present company. The whole of the profits, with the exception of one dividend, have been expended in plant and machinery from time to time (only 4000*l.* capital having been called up), and the whole of the operations are now carried on by water in place of former steam power. The lodes (mostly copper sulphurets) lie in a congenial clay-slate "country," intersected by cross-courses, elvans, and slides, all tending to increase metalliferous deposits. Valuable lodes of rich iron ores, carbonate, oxide, and micaceous also run through the setts. The machinery on the mine for pumping, hauling, transporting, crushing, and washing is all of the best order, and many influential and eminent mining captains have visited the works for the express purpose of examining the novel and admirable self-acting jigging machines and picking table, invented by Capt. Joseph Pope, on the mine, and which have already effected a saving of from 20 to 25 per cent. compared with the system of dressing formerly adopted.

GAS FROM MIXED COAL.—The results of some important experimental observations made by Dr. Stevenson Macadam, F.R.S.E., were given in an interesting paper by that gentleman. The experiments were undertaken for the purpose of determining the quantity and quality of gas obtained by the distillation of certain mixture of coals, as contrasted with the coals taken separately. Some samples of coals were selected for examination, and these were distilled in a small gas work connected with a fully equipped apparatus. Each of the coals was examined separately, and thereafter the various coals were mixed in the proportions indicated by the separate analysis as likely to yield 10,500 cubic feet of gas, with 30-candle power, for every 5 cubic feet of gas consumed during a single hour. The mixed coals were in each trial placed in the same retort, heated to a uniform temperature, and the experimental results demonstrated that where coals of different gas-producing power are heated in the same retort they yield a gas of superior illuminating power to that obtained from a mixture of the gas evolved from the same coals heated in the same proportions in separate retorts. Thus, two coals, which heated separately would yield from 1 ton 10,306 cubic ft. of gas of 30·09 candle-power; when heated together give 10,714 cubic feet of gas, of 32·27 candle-power; three coals were then used with similar differential results. Nine trials of mixed coals showed that the average increase of the illuminating power of the gas evolved from the mixtures of coals heated together in the same retort, as contrasted with the gas yielded by the same coals distilled in separate retorts, was 7·57 per cent., or 1-13th more of illuminating power.

INTERNAL TEMPERATURE OF THE EARTH.—The Committee on Underground Temperature reported that they had tried various experiments on underground temperatures at Glasgow, Dundee, and wherever they could get access to very deep wells or borings in the earth. But the chief experiments had been tried in a well made many years ago at Kentish Town, by a company formed for the purpose of supplying the district with water. The total depth in this instance was 1032 ft., 540 ft. of which consisted of a bricked well, and the remainder of a boring lined with thin sheet-iron. The well was made first, but as the people in the neighbourhood complained of the hardness of the water, the boring was done, the result being that the supply fell off, and the company ruined itself after spending 100,000*l.* on the works. The committee had obtained the use of the old well, and fitted up winding apparatus above it in a hut, to let specially-constructed thermometers up and down in the boring. The general result of the experiments was to prove an increase of temperature of 1° for every 52·4 ft. increase in depth.—Mr. S. J. Mackie, F.G.S., said that he thought the

theory of the internal fluidity of the globe to be untenable. Yet, if the increase in temperature mentioned by Mr. Symons continued the same at all depths, at about 450 miles below the surface of the earth the temperature must be equal to that of the surface of the sun. From diagrams on the wall he noticed that the increase of temperature only became regular after the bricked portion of the well was passed, and the boring reached. He thought that, perhaps, the conduction of the iron tube would tend to equalise the temperature, and that if the sides of the boring had been rock irregularities in temperature would have been recorded.—Mr. Symons said that the iron tube was thin—only about 1-10th in. in thickness, and 8 in. in diameter. It would be a good plan to sink a short length of such a tube in the ground, and to find out whether its conduction of heat influenced the results.

EXTENSION OF OUR COAL FIELDS.—Prof. Warington Smyth read an interesting paper "On the Denudation of the Shropshire and Staffordshire Coal Field," by Mr. J. Randall, F.G.S., of Madeley. It treated on the mineral character of some of the coal seams in the field in question, and showed how many of the seams were cut off by denudation. The fauna and flora belonging to these coal seams were mentioned. The Staffordshire and Shropshire coal fields were only portions of one original tract. He thought that a sea or strait had existed over the area of the coal measures, which had denuded them. Mr. Smyth said he was himself attracted to the subject from knowing the neighbourhood. The subject was interesting as dealing with the great national question of the practical extention of our coal fields. The great question was as to whether certain seams were capable of being worked at a certain depth.—Mr. Lionel Brough said that in the neighbourhood of Wolverhampton and Cannock Chase there were great dislocations. He did not agree with the author that a strait had ever existed over the area mentioned. With regard to the continuity of the South Staffordshire coal field in Shropshire, it was interrupted by faults. He thought that if they sunk deeper in Shropshire they might come on the Staffordshire coal seams, although, perhaps, under various other appearances.

BOILER EXPLOSIONS, AND GOVERNMENT INSPECTION.—In the Mechanical Section the question as to the desirability of placing steam boilers under Government inspection was fully discussed. Mr. Bramwell remarked that the number of deaths caused by boiler explosions was not one-tenth of those which occur through carriage accidents in the streets of London alone. He thought, however, that such a lamentable loss of life ought to be prevented, and was of opinion that people ought to be able to live in the vicinity of boilers without a constant fear that an accident will take place. He contended that coroners ought to avail themselves of professional advice when enquiring into the causes of explosions, believing that such direct enquiries would do more to prevent the recurrence of those catastrophes than Government inspection. In conclusion, he suggested that no one should be allowed to make a boiler unless he had previously demonstrated that he was fully capable of doing so.—Prof. Rankine thought that if more responsibility were enforced upon the owners it would have greater effect than placing the boilers under Government inspection.—The Section generally appeared opposed to the idea of Government interference, but was in favour of inspection by associations or local officers—the former proposition evidently meeting with the most approval.

CONFERENCE OF MINERS.

The adjourned Conference of delegates from various associations of coal miners was commenced on Monday, in the Manchester Mechanics' Institution,—Mr. T. HALLIDAY in the chair. The delegates represented societies in Wigan, Farnworth, and Kearsley, Oldham, Ashton-under-Lyne, Hyde, and Dukinfield, St. Helens, Haydock, and Worsley. After the transaction of some preliminary business, a letter was read from Mr. McDonald, President of the Miners' Union, counselling the Lancashire miners not to make a final demand for an advance of wages until they had given their employers a month's notice of their intention.

The CHAIRMAN reviewed the deliberations of the Conference at its former sittings, and remarked that the agents who had been sent out into various districts of England and Wales had done much good in propagating the principles of unionism. He urged them to introduce the eight-hour system, and to agitate for increased wages. It was of the utmost importance that they should obtain the eight-hour system; and, by diminishing the out-put of coal, ensure their future welfare. Several delegates reported to the Conference the result of their labours in Wales and some of the Midland Counties.

Mr. GEORGE PICKARD had met with great success in his tour through Staffordshire, but the district was so extensive that he should be compelled to make a second visit. He had found a general desire amongst the miners to introduce the eight-hour system, and to diminish the present rate of production. In one part of Staffordshire he found a man engaged in supplying the South Yorkshire coalmasters with men to take the place of Unionists who were locked out or on strike. The man seemed to be a dealer in human flesh. The masters had beaten the Union men because they could always rely upon getting a sufficient number of non-Unionists to do their work. The miners must become united in one great brotherhood, and then the day of their emancipation would be near. He drew attention to the state of the Wigan coal field, and said that he had reported to the Government that a particular mine was dangerous. The Government Inspector had the impudence and audacity to say there was no gas, but the mine had since been fatal to 85 persons.

Mr. LEWIS gave an account of his visit to various mining districts in North Wales. He found men working at Brymbo for 2s. 8d. a day of 10 hours, and producing 24 cwts. to the ton. He had received general promises of adhesion to the plan of shorter hours of labour and higher wages.

The CHAIRMAN had attended numerous meetings in South Wales, and found the same feeling there as Mr. Lewis had seen in the North. He advocated a measure by which all questions between masters and servants should be heard and adjudicated upon by stipendiary magistrates, in place of the present unpaid justices, very many of whom were large employers of labour.

A discussion took place as to whether it was advisable to extend the agitation movement, after which Mr. RICHARD COLLIER (Wigan) moved that it should be carried on for another month.—Mr. WILLIAM MILLS (Rochdale) seconded the motion, which was passed.

The Conference then proceeded to discuss the question of a reduction of the hours of labour to eight, and the best time for commencing the system.—Several speakers were in favour of delay, on the ground that the organisations throughout the country were not in such an efficient state as to warrant such a step, and further that the minds of the workmen should be ascertained on the subject. One delegate spoke in favour of postponing the discussion until the delegates from the Wigan district could be present.—Mr. PICKARD said the Wigan delegates had decided not to attend the Conference, in consequence of some misunderstanding as to the time when it met, but they had sent him to represent them, and to say that they were willing to abide by the decision arrived at.—Mr. WILLIAM JONES moved that the question should be postponed for three months.—Mr. JAMES WHITEHEAD moved, as an amendment, that the question should only be delayed for a month.—On the vote being taken, the amendment was carried by a majority of 42 to 22.

The next question for consideration was the demand for an advance of wages, and when the notices should be issued. Several delegates expressed an opinion that the masters should be respectfully asked for an advance before an imperative demand was made.—It was proposed by Mr. HAYES, and seconded by Mr. BOARDMAN, that a circular should be sent to the masters, soliciting them to give an increase of wages to the extent of the amount of the last reduction, the increase to be given on Sept. 1.—Mr. JAMES GEE moved, and Mr. GEORGE CHANTRY seconded, an amendment, to the effect that the date should be postponed to Sept. 18.—Another amendment was proposed, that the date should be Oct. 1.—The first amendment was carried by a large majority.

The Conference then adjourned.

The adjourned Conference of delegates from the various associations of coal miners in Lancashire was resumed on Tuesday, Mr. T. HALLIDAY in the chair. There was a large attendance of delegates.

THE HAYDOCK COLLIERY EXPLOSION.—Mr. WILLIAM PICKARD said that at the last Conference they had agreed to petition Government in favour of having a stricter enquiry into the recent coal mine explosions. The inquest at Haydock had been concluded, and reference had been made at that Conference to the 85 deaths which had occurred in that colliery. The members of that Conference had petitioned the Home Secretary to have a special enquiry into that explosion, and they had doubtless seen the statement made by Mr. Bruce in reply to Lord Elcho in the House of Commons on the subject. The Government was convinced that these slaughter-houses were being daily multiplied through a deficiency in ventilation. He had closely watched the proceedings at the Haydock enquiry, and he was able to tell them that during the seven years he had been a miners' agent he had never seen such a searching enquiry. From the Coroner to the foreman of the jury a latitude had been given such as he had never experienced before. If the press, which had now spoken out, continued to do so, the result would be that in the forthcoming session of Parliament the Legislature would see its way to pass a Bill for the protection of human life in coal mines, and to give greater security to the rights of the miners. It had been admitted that the tale of the miner was a true one; and he believed that the time had arrived when Government would be compelled by the force of public opinion to give greater protection to the interests of the mining classes.

The CHAIRMAN said the question was one of great importance. He had received a copy of a statement from Mr. Overton, the coroner for the northern division of Glamorganshire, in the form of suggestions for the amendment of the Coal Mines Inspection Bill. In the course of his observations, Mr. Overton drew attention to most of the accidents which had occurred during the last 20 years. The more severe accidents which he had enquired into were one in 1849, in which 57 lives were lost; one in 1850, by which 13 lives were lost; and two years later, in the same mine, another accident occurred, by which 65 persons lost their lives. In 1853, 1854, and 1855, no serious accidents occurred in his district. In 1856, however, 114 persons were killed in one pit; and in 1858 two accidents took place, in one of which 19 and in the other 12 lives were lost. In 1860, 16 persons were killed in one accident; in 1861, 13; and in 1862, 47. In 1865, 34 lives were lost; in 1867, 178 men were killed at Ferndale, and again at the same place on the 10th June last, 53 lives were lost. The total number of inquests held by Mr. Overton, in 1864, was 140, which was considerably more than in any other district in the kingdom, and the number of lives lost was 115, which was the greatest number with the exception of West Lancashire and North Wales, where owing to a succession the number was greater; and, when compared with the quantity of coal raised, was far greater than any other district of the kingdom. Mr. Overton's statement went on to say:—

"The coal proprietors were in the habit of appending to the rules sanctioned by the Secretary of State several rules of their own, which were totally unconnected with the authorised ones, and were calculated to confuse and deceive the men. The rules in the same district varied materially, and were not consistent with each other; and many of them were so illogically worded and badly arranged that it was difficult to ascertain their proper meaning, the consequence being it was difficult to obtain a conviction for the breach of any of them. The rules ought to be revised and made, as nearly as possible, to assimilate in each district, so that the men leaving one colliery would understand the rules of another. The employment of young boys as doorkeepers to accompany haulers, instead of being stationed at the doors, ought to be peremptorily forbidden. There should be authority given to the Inspectors to prevent the firing of shots in working coal in fiery veins. The provisions contained in the Mercantile Marine Act should be extended to mines. That Act required that all officers, on whose intelligence the lives of their fellow-workmen depended, should be certificated, and that all underlookers, viewers, overmen, and others should be examined as to their intelligence and experience by a competent board before being allowed to undertake any work of supervision. Colliers themselves ought to be subject to some examination before being allowed to go to work. No proceedings should be set aside for informality. The men ought to be allowed compensation if they were prevented from working by deficiency in the ventilation, or insufficiency of trucks, or any other cause which could be avoided. A central board, consisting of an experienced legal adviser, acquainted with mineral matters, should be appointed to take the superintendence of the management and working of mines, and to assist in all enquiries relating to accidents. An alteration in the criminal law was necessary. There ought to be a medium offence between accidental death and manslaughter; and in cases where accidents arose from want of proper and sufficient supervision, precaution, or management, or from disobedience to the rules, but not of so serious a nature as to amount, actually, in the opinion of the jury or justices, to wilful neglect or to constitute manslaughter, the coroner's jury or the justices of the peace should have the power of finding the persons concerned guilty of a minor offence, and send them for trial accordingly."

Mr. PICKARD said that since their last Conference the National Association of Miners had met in Leeds, and had expressed itself satisfied that good had been the result of the strong expression of opinion that they had sent through the country. The National Association had empowered him to take cognisance of the whole circumstances in connection with the Haydock explosion, and to report at the next meeting, in January, with the view of taking the matter into Court, if the evidence justified such a course. He was glad that an open verdict had been brought in by the Jury, although at the same time he could not see any other course open to them. (Hear, hear.)

Several delegates having given their views on the subject, Mr. J. WHITEHEAD moved:—"That this Conference pledges itself not to rest satisfied until a Bill is granted us for the protection of human life in the mines of this country."—Mr. WILLIAM HAYES seconded the motion.

Mr. WORRALL said the public were far from satisfied with the slaughter which took place in the mines of the country. He suggested that men should be employed in Manchester and other large towns to obtain signatures to a petition to Parliament in favour of legislation on the subject.—The resolution was passed.

Resolutions were passed tendering the thanks of the Conference to the press for the kind way it had laid the miners' grievances before the public, and expressing approbation with the way in which the Haydock enquiry had been conducted, and approval of the verdict which had been returned by the jury.

The Conference then proceeded to discuss the proposed rules for the Government of the Amalgamated Association of Miners, which occupied several hours. The first rule, which states the objects of the Association, is as follows:—

"This Association shall be called the Amalgamated Association of Miners, which shall consist of as many lodges and districts as may from time to time conform to the rules, and shall have for its objects the raising of funds by contributions and levies made upon lodges and districts, at an equal rate per member, according to the number of members in such lodges or districts, for the following purposes:—Legislating for the better management of mines; to protect the miners' lives, promote their health, and to increase among them a higher moral status in society; to obtain compensation for accidents where the employers are liable; to assist all districts and members when unjustly dealt with in point of law or legal rights; to assist all districts or members when driven into an unavoidable strike, or when locked out; to make the hours of labour of all miners not more than eight in the twenty-four; to encourage districts to raise a fund to assist its members when permanently injured in the mines, by which they are rendered unable to follow any kind of employment; to establish an agency to carry out the principles of this Association, and to pay for the management of the same."

The following are rules 14 and 15:—"Should a pit or colliery be locked out, or forced into a strike, and the funds will not meet the demands, the executive shall have power to fix a levy upon all districts, at an equal rate per member, sufficient to allow a weekly sum of 10s. to every member so locked out or on strike, and 1s. per week for every legitimate child who is not working and under twelve years of age."—"That this Association shall in no way support, defend, or countenance any member who shall in any way break the peace or violate the laws of the country; the objects shall be to keep the peace, and to prevent as far as possible any undue advantage being taken by employers or employed."

The rules were approved by the Conference, and referred back to the different districts for the consideration of the men.

The CHAIRMAN said the question of the South Yorkshire strike was referred back to the men at the last Conference. He did not know what had been done, but he thought it was desirable that something should be done to support the men who are out on strike.—Mr. PICKARD said the question had been laid before the district which he represented, and the conclusion was come to to grant 20*l.* from the local societies funds. He believed some of their lodges were supplementing that amount as their circumstances permitted.

Mr. BOOTH (Ashton) said his district had contributed regularly.—Mr. J. MORRIS (Worsley) said 15*l.* had been forwarded from his district.

A motion was passed expressing sympathy with the miners of Yorkshire, and pledging the Conference to press upon their constituents the necessity of giving them still further support. After the disposal of some other business the Conference adjourned.

A notice has been issued announcing that the intended Miners' Conference will take place at Dudley on Sept. 6, when delegates are invited to meet a deputation from Lancashire and North and South Wales. In the notice miners are thus addressed:—"The present degraded and unenviable condition in which the miners of the above places are now found is proved to arise mainly, if not entirely, from the practice so prevalent, not only in South Staffordshire and East Worcestershire, but in all parts of the British Isles where coals are being raised—over-production and the long-hour system. This is to call upon you to arouse yourselves and join your fellows in Lancashire, Yorkshire, Derbyshire, Cheshire, North of England, and North and South Wales, to remove those pernicious evils, and thereby secure to yourselves a higher rate of wages."

MANUFACTURE OF IRON AND STEEL.

The invention of Messrs. G. H. BENSON, C.E., of Staleybridge, and W. G. VALENTIN, of the Royal College of Chemistry, relates to a mode of and apparatus for mixing and fusing together irons of various qualities for the purpose of producing steel or wrought-iron applicable to various useful purposes for which steel or wrought-iron of the ordinary manufacture is usually employed. The production of cast-steel, by fusing together malleable or wrought-iron and cast-iron or pig-iron on an open hearth or furnace basin is not new, as several patents have been granted for processes based on this principle, the first of which was granted to Josiah Marshall Heath, in 1815, but we believe that this and other subsequent processes for producing steel by the mixture of malleable iron with molten cast-iron were not commercially successful, also that a kind of soft steel containing a low percentage of carbon, and approaching malleable or wrought-iron as well as wrought-iron itself, were never produced in masses kept liquid in a furnace, or run and cast into ingot moulds with commercial success, owing to the difficulty of keeping the mixture of irons at a sufficiently high temperature to maintain it in a fluid state. We have discovered that the required temperature may always be maintained if the furnace be heated by a combination of highly heated combustible gases, and a blast of heated air introduced and maintained therein under pressure, so as to prevent the ingress of the external air through any of the doors, cracks, crevices, or other openings in the furnace, and which air would lower the temperature of the furnace and cause the molten iron to thicken. We are thus enabled to effect the melting of the metal in a more effectual and economical manner than heretofore, and moreover to control the operation thoroughly and to accelerate the melting of the metals, because we are able to avoid any inequality in the flame or intermittent heat. And we would here observe that for the generation of the combustible gases to be used for the purposes of our invention we prefer to use the improved gas generator or apparatus for which we have applied for Letters Patent concurrently with this application.

In carrying out our invention we construct a short reverberatory furnace in form something like an ordinary puddling furnace, which is heated by a mixture of combustible gases and air under pressure. This furnace consists mainly of a hearth or basin nearest to the side from which the flame from the combustible gases enters the furnace for the melting down of pig-iron, and of one or two hearths or chambers on the side where the flame passes out of the furnace for heating the scrap wrought-iron, or other suitable wrought-iron, which we mix with the pig or cast-iron that is melted in the body of the furnace. The hearths or chambers for heating the scrap wrought-iron previous to its introduction into the melting basin may be constructed one underneath another, and heated either by the gases passing off from the melting chamber or by a separate supply of combustible gases. At the end of the scrap iron heating chambers we prefer to construct a bridge or wall of greater height than the bridge between the principal melting basin and the heating chambers, so that the heated gases and flame from the former will pass over the scrap or wrought-iron or other suitable malleable irons in the heating chamber, and will not impinge thereon. The bottoms of the melting and heating chambers are formed of hollow iron boxes, through which air is made to pass, in order to keep them from being destroyed by the heat. Upon these metal boxes we put a layer of highly refractory material, such as fire-bricks, ganister bricks, or ganister well rammed down; a thin layer of pulverised silica is next fused thereupon into a pasty mass, and fresh quantities of silica are added and fused, until the whole has become melted into a compact quartz-like layer or bottom of from 4 to 12 in. in thickness. When the desired thickness has been obtained and the final fusing thoroughly effected, the siliceous mass should be allowed to get nearly cold, when it may be faced by melting small pieces of scrap iron placed all over the furnace bottom under a reducing flame.

Hoppers provided with double doors, valves, or slides are adapted to the sides of the furnace, for the purpose of charging in the metal bars scrap iron, or other suitable metal. Tapping holes are also provided for running off the slag and for discharging the molten metal into suitable receptacles. The hole for discharging the metal from the furnace is made at a part of the wall which is cut away or bevilled, so that a ladle or moveable ladle furnace may be brought close under to receive the molten metal. As the highly decarbonised metal which we produce is liable to get stiff if cold air is allowed to come in contact with it, we construct the ladle furnace in the form of a close vessel, mounted on wheels for the convenience of transport, and provided with an opening or openings, through which heated gases and blast from the furnace, or from any other source, may be blown or introduced into the interior for the purpose of keeping out the cold air, and keeping up the temperature of the metal until it is run into the ingot mould. We operate practically by first getting up an intense heat in the melting chamber or basin by means of the combined blast under pressure, so as to melt down the pig-iron very rapidly. We thus avoid oxidation and consequent loss of metal as much as possible, and obtain a clear metal bath. As the steel, wrought-iron, or other suitable admixture, requires a much greater heat in order to melt it down, we heat it first in the heating chamber or chambers by the spent heat, or by means of a separate flame or flames, previous to its introduction into the metal bath. In consequence of the gases being under pressure we are able to effect these objects without cooling the furnace by any indraught of cold air on opening the charging door for the introduction of the tools for removing the scrap wrought-iron over the fire-bridge into the molten metal bath. For the same reason we can melt down the wrought-iron far more rapidly and uniformly until by one or by repeated introductions of scrap iron, steel, or other partially or wholly decarbonised iron, the bath has undergone the required amount of decarbonisation, and the metal been converted either into hard or soft steel, or into a so-called homogeneous iron.

We are enabled to make a kind of steel approaching wrought-iron, such as cannot be made by the well-known Bessemer process, since a more intense heat is required to keep such steel in a fluid condition, and because even a slight decrease in the temperature of the flame chills it and renders it unfit for the purpose of casting in moulds or ingot forms, and gives rise to loss from skulling. The flame being completely under control and of a steady and non-intermittent nature, we are enabled to urge the heat of the furnace in a much shorter time to a hitherto unattained degree and to make a metal that is nearly decarbonised. This metal, which is practically wrought-iron, we are enabled to keep in a perfectly liquid state, and to cast it into ingots, or work it up into any articles for which wrought-iron has hitherto been employed.

FOREIGN MINING AND METALLURGY.

The advices received from the principal coal mining centres of Belgium are tolerably favourable. There are continued complaints of the insufficiency of means of transport on the State railways; in the Charleroi basin stocks have, it is said, accumulated, in consequence of trucks having almost completely made default. Orders for coal have shown considerable activity; the consumption of the various industrial establishments is continually increasing, and a considerable demand has also prevailed irrespective of those establishments. In the Lower Sambre district there are also many orders, but the deliveries have been greatly restricted, in consequence of the want of transport matériel. The condition of the coke trade is very prosperous. In the Liége basin a further advance of 10d. per ton will be made as from Sept. 1; business in the Liége basin has been tolerably active. A large amount of activity prevails in the Belgian iron trade; the orders on hand are numerous, and embrace generally all metallurgical products—merchants' and other iron, plates of all sizes, and castings and pig of every description.

The general state of the markets of the Haute-Marne remains unchanged; transactions are well sustained, but do not present very great importance. Some transactions in coke-made pig have been concluded, in consequence of visits made to forgemasters by representatives of blast-furnaces in the East of France; the terms agreed on are stated to have been 2*l.* 14s. 6d. per ton, in warehouse at the producing works. The demand for charcoal-made pig, instead of improving, becomes worse and worse; producers are extinguishing their furnaces, and there are now only four or five in activity. The quotation for charcoal-made pig is purely nominal, but notwithstanding this it would be difficult to do business at 4*l.* 4s. per ton. Special irons and sheets are in great demand. Merchants' iron is somewhat quieter. Rolled coke-made iron has made from 8*l.* to 8*l.* 8s. per ton, according to contracts; mixed ditto, 8*l.* 12s. to 8*l.* 16s. per ton; and charcoal-made ditto, 8*l.* 16s. to 9*l.* 4s. per ton. Machine iron is the object of such numerous orders that it is tending upwards. No. 21, coke made, is held at 8*l.* 4s. to 8*l.* 8s.; No. 20, coke-made, has made 8*l.* 8s. to 8*l.* 12s.; ditto puddled charcoal-made, 9*l.* 16s. to 10*l.* per ton. A quotation of 2*l.* 14s. 6d. per ton for rough refining pig appears to have been established by the works of the Meurthe and the Moselle; some producers, relying on the fact that their production is engaged up to the end of the year, profess to anticipate more remunerative rates in connection with contracts about to be concluded; they would be disposed, however, to enter upon large transactions at current rates—that is, at 2*l.* 14s. 6d. per ton. Some small affairs have been concluded at 2*l.* 15s. 4d. per ton. Of course, the producers of the Moselle and the Meuse have a perfect right to advance their terms if they think fit to do so; at the same time they would, perhaps, do well to bear in mind the fact that they almost entirely failed to secure orders in connection with contracts let by the Eastern of France Railway Company, for small matériel required for its system. Thus, only one forgemaster of the district, M. Labbé, obtained an order for a small lot; the fish-plates and bolts ordered will be supplied by the Nord. The Providence Company is about to construct a new furnace at Rehon, in order to produce second-fusion pig. M. Mironfle, of Demange, in the Meuse, has obtained a contract for works of canalisation, to be executed in connection with fountains at Bazoilles; pipes and castings will be required to the extent of about 150 tons, and a Bar-le-Duc establishment will supply them at the rate of 6*l.* 8s. to 6*l.* 10s. per ton. The same establishment will deliver pipes required for the canalisation of Domrémy-au-Bois, at 6*l.* 12s. per ton. An adjudication has just taken place of contracts for three lots of telegraphic wire, each of 150 tons, required for the French administration of telegraphic lines. One lot was let to the Châtillon Company, at 311*l.*; another of to the Franche Comté Company, at 311*l.*; and a third lot to MM. Boigues, Rambourg, and Co., at 312*l.* The minimum price at which one lot was let on May 31 having been 298*l.*, it is shown conclusively enough that prices have experienced a notable advance during the last three months.

The French copper markets have shown some tendency to revive of late; prices have not experienced much change, however, at present. There has been rather more firmness in the Berlin market, but previous prices remain unaltered. The same may be said of the Dutch markets. At Rotterdam, Russian is quoted at 51 fls., and Drontheim at 50 fls. to 52 fls. Tin has not presented much change upon the French markets, upon which transactions have been comparatively unimportant. At Marseilles there has been an advance of 4s. per ton in English tin. The German tin markets are generally rather weaker. The Dutch tin markets have also shown little animation. At Rotterdam some transactions have been concluded at rather lower rates; Banca has made 79 fls., and Billiton 77 fls. At Amsterdam the demand for Banca has been very quiet. At Paris, Spanish lead has made 19*l.*; French, 19*l.* 4s.; English, 18*l.* 16s.; and German and Belgian, 19*l.* 4s. per ton. On the German lead markets no important changes have been noted. Zinc has generally experienced little change. At Marseilles rolled zinc has brought 30*l.* per ton.

The Douvrin Colliery Company has ordered the issue of 500 preference shares, similar to those already issued, and bearing an interest of 1*l.* per annum. The sum derived from this issue is intended to be devoted to the establishment of a short railway from the first pit of the Douvrin Company to the canal from the Aire to the Bassée, and to the railway from Lille to Béthune. Further, it is proposed to establish works for the production of agglomerates from ordinary coal; the inferior Douvrin coal, hitherto little sought after, will thus easily find new outlets. The agglomeration will be effected on a system of which the Carvin Company has a monopoly in the Nord and the Pas-de-Calais. In order to secure an immediate commencement of the works determined on, the Council of Administration has been authorised to raise a temporary loan of 400*l.*, to be re-paid out of the capital to be raised by means of the new shares. In 1867 the French General Steam Transport Company carried 120,000 tons of Algerian minerals, in 1868 this total increased to 181,000 tons, and the engagements entered into for the current year are in round figures 200,000 tons. The minerals carried are principally those of Mokta-el-Hadid. The report of the Chamber of Commerce of the arrondissement of Bochum has just appeared for 1868; it presents some interesting statistical data on the results obtained in 1868 by mining industry in this part of the Prussian monarchy. The arrondissement of Bochum comprises nine collieries, which furnished employment last year for 16,992 men, and produced 17,648,324 tons of coal. A lead mine in the arrondissement also employed six men last year, and produced 59 tons of minerals. The association engaged in mining industry and the production of cast-steel at Bochum produced in 1868 10,982 tons of cast-steel. The association further produced 4464 tons of steel according to the Bessemer process. The total number of workpeople employed by the association was 1950.

THE MINERAL WEALTH OF PORTUGAL.—The development of the enormous mineral resources of Portugal progresses each year more rapidly, mining enterprise in that country now showing itself in all directions. The mines now opened consist of 23 coal, 45 iron, 98 copper, 20 tin, 66 lead and silver, 6 gold, 85 manganese, 6 antimony, 3 quicksilver, 3 asphalt, 1 sulphur, iron pyrites, and 1 phosphorite; and of this total of 357 there were 229 in full operation, 137 having from different causes ceased to be worked. The most assuring feature, however, is the great effort that is being made to discover and utilise the undeveloped wealth of the kingdom. In 1853 there were but two mines in existence in the kingdom—the San Pedro de Cova Anthracite Mine, near Oporto; and the Braçal Lead Mine, in Aveiro. Although Portugal cannot claim the abundance of silver which exists in Mexico, it has coal, petroleum springs, iron, lead, and tin, whilst copper is so plentiful as to be most profitable to those who work it. To facilitate the development of its mineral riches the kingdom has been divided into four mining districts—the province of Minho, which at the close of last year possessed 45 mines; Beira Alta, Baixa, which contained 56 mines; the province Estremadura, with 31 mines; and the province Alemtejo Algarve, having 133 mines. Over each of these divisions is placed an engineer, who exercises inspection; and these form a council, of which the Minister of Public Works is the head, to direct mining operations. What the present mines might produce if more thoroughly worked, to say nothing of the hundreds of acres of unexplored earth, may be judged from the produce of the single mine of San Domingo, which three years ago was valued at over 500,000*l.* sterling. The presence of coal is well developed at San Pedro da Cova, Bussaco, and Moinho da Ordem, but it is only in the first-mentioned place that it pays working expenses. Leira is known also to contain coal at Cape Mondego; and at the Mine de Chao Preto researches are being conducted by the Iron and Coal Company of Portugal to discover the depth of the seams. Attention is drawn to the important coal mine at Belmez, in Andalusia, which it is thought is likely to have an influence on the importation of English coal into Portugal. The coal is stated to be of superior quality, and the Great Northern Railway Company have already made arrangements for a considerable supply. The mine is situate about 480 miles distant from Lisbon, but direct railway communication has now been effected with the capital and with Madrid, the railway being now continued to Cordova, which is already in communication with Cadiz. The Andalusian coal reaches Lisbon at 22s. 6d. per ton, which is somewhat higher than English coal, though the reduction of the Spanish railway tariff could effectually exclude the latter coal. At Da Granja a stratum of bituminous sandstone has been explored. Iron is abundant in all the provinces of the kingdom, and is found in several geological formations, the mountains Serra dos Monges being the most important and productive. But all others are surpassed by the copper mines. The mine of Palomal alone in six years produced 8539 tons of copper. Three of the mines in this province, extending over 68 miles, are said to form a continuation to the metallic region of Spain. But the mine of San Domingo has surpassed in productiveness all the mines of the Spanish province of Huelva; for, since the year 1859, 709,000 metrical tons of iron pyrites have been exported from it to England; and a French company expects, on the completion of its works now in progress, to be able to furnish the large quantity of 200,000 tons of iron pyrites annually. In order to give an opinion relative to the development and progress of the mining operations of San Domingo, it may be said that in the year 1858 one humble hermitage existed on the range of hills which are now peopled with habitations for miners, with stables, and with workshops in connection with the mine, consisting of 524 different buildings; 300 furnaces for baking the ore are being prepared, after which operation it is submitted to a process of tritu-

ration, previous to another process for separating it by means of hydraulic sieves. The ore having undergone the process of baking and sifting, is destined at once to produce copper. In 1862, 2000 workmen were employed in this mine, of whom 800 were employed underground. The Romans seem to have extracted a large quantity of ore from the richer veins of San Domingo, as well as from the mines of Grandola.

THE MINING INTERESTS.

The marvellous success attending the Van Mine has infused fresh enterprise, not only in the immediate locality, but throughout Cardiganshire, Carmarthenshire, and the various mineral fields of South Wales. This might very reasonably have been expected, from the sudden creation of a property valued at half a million sterling; which not only enriches the fortunate adventurers, but disburses throughout the district a large monthly expenditure both in labour and merchandise; thus distributing the advantages amongst a widely extended circle, in addition to those more especially benefitted by the receipt of prospective substantial dividends. The spirit of speculation has led to many fresh mines being opened, and it would appear that the prospects of success are marked and significant in two or three; this is the more remarkable when we reflect upon the fact of the district, until of late, having been regarded as exceptionally barren, and consequently neglected. It is true that Bryntail in former years gave a few small dividends, but these were more than absorbed in subsequent calls, whilst for many years the workings were continued upon a very restricted scale, and the chief attention of the company directed to the production of barytes; the success of the Van Mine, however, has called attention to the former yield of lead, and as the same veins traverse the two setts, of course it is pretended that both must prove equally valuable, so that Bryntail, as Van Consols, has sprung into public recognition, and the very encouraging, though neglected features "that for years remained in abeyance," now render it a general favourite in London. It is divided into 12,000 shares, at 2*l.* 10s. each. The Aberdaunant is very justly spoken of as a mine of more than early and average promise; that the lodes are productive there can be no doubt, but should the reported yield of 1, 1½, 2, and 4 to 5 tons of lead per fathom become a realised fact, it is within the scope of probability that there may be more than one "Van" in the district, and that the proprietors of Aberdaunant may be the next to congratulate on success.

In the West of England we have the West Chiverton, a mine of wonderful yield, when regard is paid to its sudden rise into profits and public appreciation. At present this is the most profitable mine in Cornwall, and pays 2*l.* per share dividend quarterly, on 3000 shares, marketable at 52*l.* each, equal to 16 per cent. on market price. The cost to the present company was only 30,000*l.*, and the dividends are 24,000*l.* annually. In the district of this valuable property there are many other mines at work, some of which promise early success, whilst none, probably, is more worthy of public support and recognition than the Great South Chiverton. The works are being carried out with practical skill and economy, and it is rarely our province to record a notice of a young mine wherein more spirit, enterprise, and encouragement are combined in the development. Passing on west to the Redruth and surrounding district, we have several mines of great and unusual prospects, and there can be little question entertained of early and substantial prizes being discovered. The history of the past in regard to this profitable mining field is marvellous beyond any other throughout Great Britain, and were we to enumerate one-half of the prizes our readers would barely credit the fabulous gains. The Dolcoath has been at work for three centuries, and the present company in existence since 1806. The yield has exceeded twofold the Devon Great Consols, whilst the present market value is 123*l.* per 1432d share, the reserves being estimated at a million sterling. Cook's Kitchen, adjoining, yielded 300,000*l.* gains in an area of 300 fathoms only in length. Tincroft, now selling for 16*l.* 10s. per 6000th share, has been successfully at work for 40 years, and during the last and present century afforded dividends exceeding half a million sterling. Beyond this, again, we have the Carn Brea, a mine that yielded the present company gains of 290,000*l.*, upon 15,000*l.* expenditure; whilst under former phases it produced beyond a million sterling worth of copper and tin ores. To enter into full particulars of this district would extend beyond the limits of our present notice, we will, therefore, restrict ourselves to the mines immediately north and south of Carn Brea—namely, West Tolgus, South Tolgus, Great South Tolgus, Old Tolgus, and Great North Tolgus, stretching towards the Bristol Channel, and North Basset, East Basset, West Basset, Basset, Buller, South Frances, West Frances, and South Condurrow to the south, being all situated in a magnetic parallel, and not exceeding 2½ miles in length. The most interesting of these mines are the West Frances, West Tolgus, Great North Tolgus, and South Condurrow. We shall, therefore, confine our remarks on the others to a mere summary of results.

The Tolgus Mine at one time yielded 60,000*l.* worth of copper ore annually, and in the aggregate afforded gains of 250,000*l.* This and the continuous mines eastward—Harmony, Montague, and Great Busy—yielded copper ore of 2,000,000*l.* in value. South Tolgus, 16*l.* paid, sold at 200*l.* per share, and was a profitable mine for years. Great South Tolgus sold for 100,000*l.*, upon 10,000*l.* expenditure; whilst to the east and west we have stretching out for two miles in both directions the best mines of the past and present generation. Again, North Basset sold at one time for 250,000*l.*, upon an expenditure of 10,000*l.* The West Basset was sold for 600*l.* to the present company, and a capital of 9000*l.* subscribed, upon which the market value rose to 300,000*l.*, and up to this time dividends amounting to 200,000*l.* have been declared. East Basset at one time sold at 250*l.* per share, and was a leading favourite in the London market. The Buller, upon an expenditure of 5*l.* per share, rose in value to 1050*l.* each, whilst gains of more than 300,000*l.* have been divided upon a capital of 1280*l.* We have next the South Frances, in 496 shares, 18*l.* 18s. 9d. paid up, at one time saleable at 350 each, having declared dividends of 374*l.* 13s. 6d. per share. Lastly, we come to the Basset, a mine continuously at work profitably for nigh on half a century. The present company subscribed a capital of 1280*l.*, whilst the gains have amounted to 323,840*l.* The shares, 5*l.* 2s. 6d. paid, at one time sold for 400*l.* each, the present value is 50*l.* to 60*l.*, equal to 1000 per cent. premium. At one time the profits were 35,000*l.* annually, they are now fallen off to 1*l.* per share two-monthly, still the chances of a long successful career are in its favour.

Nil desperandum should be the motto of every true miner, as experience proves that perseverance and application ever, with rare exceptions, lead to success. The Great North Tolgus consists of 1000 shares, of 5*l.* each, and applications for shares are solicited in our advertising columns—namely, 1*l.* upon application and 4*l.* upon allotment. The merits of this company's grant has been often canvassed, and as often admitted by practical authorities to possess all the elements of a great, permanent, and valuable property; yet, from a combination of circumstances, it has never been fairly and legitimately worked. There have been several companies formed to develope it upon the limited liability principle, but operations have been chiefly directed to market dealings, instead of working the lodes underground; hence the primary cause why the Great North Tolgus has not for years past been ranking as one of our greatest and most profitable copper mines. These past partial attempts to work have had some advantages, however—namely, sinking the shafts to depths of 50 fathoms from surface, and the erection of all the necessary buildings, with other preparatory work, that will save the present company at least four years in time and many thousands in money expenditure. We, therefore, draw attention to this property as well worthy the attention of capitalists at the very reasonable price at which it is offered, whilst there can be no hesitation in predicting a good issue to the enterprise, under the practical management of the gentlemen associated with it.

We next come to the South Condurrow, a mine of considerable promise. Large quantities of tin ores are discovered, and the pioneer points of operation are mostly productive. The machinery, now in course of erection, will soon be available, upon which public attention must be drawn to the merits of the adventure.

West Frances is opening out in a most satisfactory manner. The dividends are 1*l.* 10s. quarterly. The position of the grant is as good as could be desired, the prospective fraught with promises, and the management sound and practical.

West Tolgus has proved itself to be a good copper mine: the last ale was 271 tons of ore, which realised fully the average value, and but for the greatly reduced prices of that metal would now render the property highly profitable. The future is most encouraging, and but for the universal depression still prevailing in every description of speculative enterprise would now, from inherent merits, command very general support and recognition.

ON SLATE AND SLATE QUARRIES.

BY S. R. PATTISON, F.G.S.

Chapter III.—Palæontology of the Slate Rocks.

The slate rocks were once supposed to be devoid of all traces of former life; recent investigations have corrected this supposition. In the actual slates themselves fossils rarely appear. Their presence would be a source of weakness, an evidence of incompleteness in the compacting or metamorphosing forces, and an evidence also, if they lay on the surfaces of the slates, that the cleavage was coincident with the bedding, which is usually a token of inferiority. But the softer, or the more calcareous, strata accompanying the slate veins contain fossils which serve to identify the beds, and are thus useful in a commercial point of view. By means of these we can establish divisions in the rocks more sharply and accurately than by stratigraphical position alone, and thus are guided to the true place of the profitable beds.

The group of rocks which hold the main quarries of Wales—the Bangor, or *Lower Cambrian*—contain the lowest traces of organic life yet found in England. These are extremely rare and extremely obscure; being, in fact, nothing more than the burrows of marine worms, hitherto found only by the late Mr. Salter (whose mournful aberration from overwork, and death from aberration, we are now deploring), at Moel-y-ci, near Bangor. This feeble representation of the animal kingdom is a bundle of flattened vermicelli-like tubes, lying confusedly on the surface of a sandy slate.

The composition of the slate rocks shows they were sea-bottoms and beaches, formed under similar conditions to those at present; the waves broke on the shore, heaped up little ridges of sand and mud, the waters on retiring drained into small hollows by tiny gutters, the surface became alternately wet and dry, was traversed and burrowed by sea worms, spotted with the prints of crawling or jumping creatures, dotted over with clusters of minute zoophytes. They speak to us of a world of sea-margins and depths, with living creatures suited to the situation. No sedimentary rock can now strictly be regarded as azoic (devoid of life traces), for although no fossils exist over large areas, and throughout long successions, yet somewhere in the group, at some spot on the horizon propitious to their preservation (as in the case of the Laurentian rock of Canada), the medals of creation remain.

The characteristic fossil of the lower Cambrian rocks in Britain is a small zoophyte, named Oldhamia, first found by Prof. Oldham, in Wicklow. The form of this creature is very distinct. It has not been detected as yet, save in the coarse slaty masses of the cliffs of Bray Head, in the county of Wicklow, and Howth, in county Dublin. Mr. Bailey, acting palæontologist to the Geological Survey of Ireland, distinguishes three species.*

Worm burrows, similar to those which accompany *Oldhamia*, are found in the Longmynd rocks, and in the primordial zone of Bohemia. The assemblage of life in these rocks is, therefore—

A zoophite, Oldhamia. Three species.
Worm-burrows of four kinds of marine worms. One in the Longmynds, two at Bray Head, one at Bangor, Wicklow, and Longmynd.
A doubtful crustacean of the trilobite family (Palæopyge Ramsayi) in the Longmynd.

Such are the scanty relics of what may have been a rich and varied development, whose forms are all, save these, obliterated or destroyed by the mighty agencies which have transmuted and transformed these old slaty masses.

The next group is that of the *Lingula flags*, the Festiniog slates, *Upper Cambrian*. These were long supposed to be barren of fossils, but in 1846 Mr. Davis detected the Lingula, or as it is now called Lingulella, and this discovery was succeeded by that of other fossils, all indicating a low marine life. The forms of this life are as beautiful and as perfect in their kind as those of higher organizations.

Sir R. I. Murchison, in his "Siluria" (p. 40), thus remarks concerning the Lingula:—

"The covering of this animal is very horny, and only slightly calcareous; showing that its inhabitant was suited to the conditions of a sea whose bottom was composed of mud and sand, and which contained little or no lime wherewith to supply the fabric of a thicker shell. In ascending through the different stages of the Silurian system, it will also be seen that different species of the genus Lingula occurred most frequently at those intervals in which there was a return to similar sedimentary conditions—*i.e.*, whenever the original muddy sea bottom was only slightly impregnated with lime."†

The Lingula flags abound in some places with the burrows of marine worms. These are found in the Festiniog slates, and between that place and Tremadoc. In the same localities are also found a tiny crustacean, named by Mr. Salter, its discoverer, Hymenocaris vermicauda. It abounds in the slaty rocks about Penmorfa. Not only do the slates exhibit traces of the creature itself, but tracks of the prongs whereby it skipped along like a shrimp.‡

The slates have been well searched for fossils.¶ The total contents are enumerated as follows:—

Lower Lingula Flags.... Worm burrows and tracks, 4 kinds; crustaceans, 8; Trilobites, Mollusks, 3, including Lingulella.
Upper Lingula Flags.... Worm burrows; Crustaceans, 17; Trilobites—Coral, 1; Mollusks, 3.
Lower Tremadoc Slates.. Crustacean, 1; Coral, 1; Mollusks, 5.

The next group in an ascending series, the Llandeilo, *Skiddaw slate*, or Arenig, comprises the following:—

Snowdon Slates, Lower Llandeilo—		Graptolites	10
Worm tracks	1	Mollusks	24
Crinoids	1	Coral	2
Trilobites	14	Sponge	1

The Skiddaw slates of the Isle of Man show some impressions which have been attributed to the foot-prints of a large crustacean upon soft sandy mud. The observations are as yet too few to justify positive opinion as to the true character of these markings.§

Next to these is the *Caradoc* or Bala group, exhibiting a great increase of marine life:—

Fucoids	1	Star-fishes	5
Sponge	2	Crustaceans	37
Corals	19	Phyliopods	4
Worms	8	Graptolites	16
Echinoderms	15	Mollusks—above	120
Crinoids	2		

In the slaty portion of the *Wenlock* series, the lower Denbighshire grits, no fossils have been found. The overlying beds have the following assemblage:—

Corals	3	Trilobites	1
Sponges	2	Graptolites	1
Crinoids	1	Mollusks	23
Worms	3		

In the slates of the *Devonian* system in North Cornwall a few fossils occur, especially in the cliff quarries at Tintagel. They may be seen occupying one or two zones of decomposing rock, where calcareous matter appears. Specimens occur of—

Fenestella	Spirifera disjuncta.
Crinoidal stems and plates.	Orthis.
Spirifera gigantea.	Orthoceras.

These fossils are much distorted by cleavage. In the upper beds of the great Delabole quarries the traces of Sp. disjuncta may be occasionally seen. The great assemblage of Devonian fossils is not found with the slate beds.

In the imperfectly slaty portions of the lower *coal measures* there occur those organic remains which are characteristic of the marine portions of this formation.

The fossils of the Stonesfield *oolitic slate* are distinguished by their number and beauty. Fragments of drift wood, impressions of ferns and cycads, numerous shells, insects, reptiles, and finally an opossum. These are vast cycles of ages in the geological scale above the slate rocks proper. The organic life of the latter is as the dim dawn compared with the oolitic life, while the latter is equally obscure compared with the present. Still each individual organised life-structure exhibits proofs of skill and adaptation equal to its modern successor. No traces are to be found in the earth beneath of any rudimentary condition of animal life.

The above is very far from a complete record of all the fossils discovered in the rocks containing slate. It aims to be only a sufficient enumeration to serve for identifying the strata. Discoveries of fossils are continually occurring in the lower rocks. Their very paucity and obscurity tempts the true palæontologist to the toilsome task. In a general way, the remains above enumerated will serve to indicate the stratigraphical position of any slate bed with which any of them may be found to be associated, and thus prevent, or detect, some of the grosser misconceptions and misrepresentations respecting the similarity of one slate-bearing rock to another. Fluellen's physical philosophy is substantially accurate when he says—

"I warrant you shall find, in the comparisons between Macedon and Monmouth, that the situations, look you, is both alike. There is a river in Macedon; and there is also, moreover, a river at Monmouth; it is called Wye at Monmouth, but it is out of my prains what is the name of the other river; but 'tis all one, 'tis so like as my fingers is to my fingers, *and there is salmons in both.*"

* See Geological Magazine, vol. 2, p. 391.
† See as to Lingula, Annals of Natural History, 2d series, vol. 8, p. 405; also figures and descriptions, M'Coy, p. 252.
‡ See Quarterly Journal of the Geological Society, vol. 10, p. 209. [Hicks.
¶ Plant. Quarterly Journal of the Geological Society, vol. 22, p. 505—also
§ Geological Magazine, vol. 2, p. 542.

Field Geology.—An instructive and interesting little volume of "Notes on the Geology of North Shropshire," by Miss Charlotte Eyton, has just been issued through Mr. Robert Hardwicke, of Piccadilly, and from the continually increasing interest felt in field geology it will undoubtedly prove useful to a very large number of readers. The work is divided into seven chapters, and although each occupies on the average only a dozen pages, a very large amount of information is given, and in a style too which is calculated to give it the utmost possible value. In the introductory chapter Miss Eyton points out the mutual influence of mechanical and geological science, the object of the work, and supplies a general panoramic view from the summit of the Wrekin. The description of the country more immediately under consideration, the unaltered Cambrian grits of Haughmond Hill, and the altered grits seen in the same locality occupy the next chapter, and this is followed by an account of the volcanic rock of the Wrekin and Lawrence's Hill, of the Plutonic rock of the Ercall, and of the altered rocks and Silurian beds in the neighbourhood of the Wrekin. In the fourth chapter the absence of the old red system on the northern limit of the Silurian district—the carboniferous beds there reposing immediately and unconformably upon a Silurian sea bottom—is pointed out and commented upon, and the carboniferous limestone, the productive coal measures, and the faults and disturbances observable in the district are fully referred to. The utility of the term poikilitic for denoting the sandstones of both the Permian and the Triassic period, the evidences afforded in the district of the denudation of the coal, and the character of the Permian and Triassic beds on the east and on the north-west of the coal field are then explained. In the succeeding chapter the interval of time between the secondary and quarternary deposits, the glacial drift of Strethill, and the marine drifts on the east and on the west of the plain of North Shropshire are treated of, and the concluding chapter contains some interesting remarks on the Lake Period, the Forest Period, and Atmospheric denudation. Throughout the book Miss Eyton displays a thorough acquaintance with the district and gives evidence of being an enthusiastic field geologist. The work is one which all who visit the district upon a geological excursion should be especially careful to put in their pocket.

Merchant's Ready Reckoner.—The second edition of the very useful series of tables published under this title has just been issued by Mr. G. R. Barber, of Derby, and as the calculations have been made expressly for coal proprietors, merchants, railway companies, and dealers in heavy commodities, and show the cost of any weight from a quarter of a hundredweight to 500 tons at the rate of from ¼d. to 32s., they will meet the requirements of a very large number of persons. In addition to a thorough revision and correction of the work, several alterations have been made, with a view to facilitate the calculations—the hundredweights are at the head of each page instead of the foot, and all the unnecessary ciphers are omitted. But that which probably adds most to the value of the work is the addition of a cut index, similar to those used in ledgers, so that any particular table can be instantly found. The book is strongly half-bound in sheep, and being of full foolscap size is not likely to be mislaid; it is a work which should find a place in every counting-house.

FOREIGN MINES.

Imperial Silver Quarries.—Extract of a letter from Mr. Lewis Chalmers—July 31: Fourteen feet of tunnel were made this week.

Pestarena United.—Thomas Roberts, Aug. 18: Aquavite: We are pleased to say that the lode in the 23 end, driving south, has further improved, estimated to yield now 2 tons of apparently rich ore per fm.; a separate trial of the ore from this end will be made this week; we fully expect to reach a course of ore in driving this end south. The 33 end south has also improved, yielding at present 3 tons per fm.; we shall be able to value it for gold in the course of another week. The stopes in bottom of the 46 yield 7 tons per fm., worth 2 ozs. of gold per ton. No change in the 46 end south, neither is there in the stopes throughout this and the Pe-chiera Mine. The lode in the ends, driving north and south from the so-called boundary winze, yields on an average 3 tons per fathom, worth 17 dwts. of gold per ton.—Val Toppa: No. 3 Level: In the end south from the first cross-cut we have a splendid lode, and also a good lode in the rise behind this end.—No. 2 Level: In the end south from the cross-cut, on the new lode, we are opening up some good stoping ground. No change to notice in the stopes in back of this level, on the flat lode.

Lusitanian.—Aug. 17: Sinking Taylor's engine-shaft below the 130 fm. level; the lode is worth 1½ ton of ore per fathom. In sinking the River shaft below the 100 the shaft is holed to the 110. At winze No. 79, below the 120, west of Taylor's, the lode is worth 1½ ton per fathom. At winze No. 78, below the 8, west of Perez', the lode is 1 ft. wide, composed of flookan and country. In the 130, west of Taylor's, stoping above the 110 at winze No. 67, Basto's lode, the lode is 4 ft. wide, composed of quartz and country. In the 130, west of Taylor's, stoping above the 100 east of Taylor's, on Basto's lode, the lode is 3 feet wide, composed of quartz and ore, worth ½ ton per fathom. In the 120, east of Taylor's, the lode is 4 ft. wide, composed of loose country and quartz. In the 120, west of Taylor's, the lode is worth ¾ ton per fathom. In the 110, east of Taylor's, the lode is 2 ft. wide, composed of flookan. In the 110 west the lode is 1½ ft. wide, composed of quartz. In the 90, east of River shaft, the lode is 2 ft. wide, composed of dry flookan. In the 70, east of ditto, the lode is 3½ ft. wide, composed of loose quartz and country. In the 18, west of cross-cut, on branch, the lode is worth 1¼ ton per fathom. In the 18 east the lode is worth ½ ton per fathom. In the 8, west of Perez' shaft, the lode is worth ½ ton per fathom. In the adit level, west of Perez' shaft, the lode is 8 in. wide, composed of country. In the 28, west of cross-cut, west of Perez', the lode is 1¼ ft. wide, worth ¾ ton per fathom. In the 28, east of ditto, the lode is worth 1¼ ton per fathom. In the 28, east of slide, on Ponte lode, the lode is small and unproductive.—Carvalhal: The incline shaft ground is a coarse gneiss; no lode to value. In the 50, south of incline, the ground is a hard gneiss. Rising above the 40, east of incline shaft, the lode is worth 1½ ton per fathom for lead and blende. In the 40, east of incline, on the great lode, the lode is 4 ft. wide, composed of quartz, with lead and blende, worth ½ ton per fathom. In the 30, east of incline, the lode is 1 ft. wide, composed of flookan and quartz. In the 20 east the lode is 1½ ft. wide, composed of quartz. In the 10 east the lode is 2½ ft. wide, composed of quartz, with stones of lead. In the adit level, west of incline, on caunter lode, the lode is 1 ft. wide, worth ½ ton per fathom. In the 10 west the lode is 1½ ft. wide, composed of quartz.

[For remainder of Foreign Mines, see this day's Journal.]

Australian Mining Company.—The directors have issued to the shareholders a report from the *Adelaide Observer*, which contains a very interesting and favourable account of their property, and the more gratifying as coming from an intelligent eye witness, without any bias from pecuniary interest in the prosperity of the Australian Mining Company. The writer says—"Four or five miles beyond Tungkillo we caught a glimpse of the Reedy Creek Mine, lying three or four miles to the right, in one of several enclosed valleys to be met with in this portion of the country. As we descended into the plain the description of land passed through was vastly superior to any met with since leaving Tungkillo. A strong crop of grass was growing on the slopes, and evidences were not wanting that many an acre in the fertile gullies would, unless mineral discovery prevented, be shortly brought under the plough. At the very extremity of the ranges stands the rising township of Palmer, which owes its name to Col. Palmer, Chairman of directors of the English Company, and a local habitation to Mr. Bevilaqua, who held out strongly for this situation in preference to one on more elevated ground. In the mine there are lodes opened up in all directions, and bearing ore estimated at from 10 to something like 40 per cent. sufficiently attested the one fact—the ease with which the ore was conveyed to the crushing-room attested the other. The underground workings are partly carried on by tributers, and partly by tutwork men, but nowhere could it be said that operations were proceeding with unsatisfactory results. A mine that has many hundred fathoms of underground passages, and no less than seven proved lodes, exhibiting not cupreous stain, or indications of the presence of copper merely, but good solid ore of fair percentage, is raised far above the category of a mere tentative enterprise. If it does not relise the expectations of its promoters, and speedily become a dividend paying mine, it will much belie appearances. Before closing this account it will be necessary to give a short notice of the smelting works standing near the main road, a mile or two to the eastward of the township just named. They are in rather a rough state as yet, but for all that have well served the purpose of reducing the lower quality ores, which would scarcely be worth carting to the Port. There are two furnaces, by means of which 50 tons of ore can be melted weekly; and it is in contemplation to erect four others, which it is estimated will obviate the necessity of sending any ore to the Port to be smelted. The two furnaces are protected by a galvanised iron roof, and are connected with a chimney-stack 50 feet in height. It is found that the ore from the mine, consisting as it does of carbonates and sulphurets, is well adapted for smelting. A portion of it is turned out as pure blistered copper, and a portion as regulus. The buildings stand in the centre of three sections purchased by Mr. Bevilaqua, and the chief reason for having them here instead of at Reedy Creek is that timber in the one case is plentiful, and in the other scarce. There are about 1700 tons of wood cut up and stacked near the furnaces ready for immediate use."

Mining by Machinery.—Mr. Dœring has undertaken forthwith to erect six of his improved boring-machines at Dolcoath Mine, having accepted very liberal terms for the use of the patent. He has also concluded an arrangement for the extensive application of his machine in Wales.

Drills for Boring Coals.—Mr. C. J. Chubb, of Tavistock-square, proposes to employ a drill, the cutting end of which is formed with teeth to cut first into the coal an annular hole, leaving a cylindrical core standing in the centre. This core is afterwards broken up by other cutters or projections on the central portion of the end of the bar which forms the stem of the drill, which is twisted or formed into a screw to remove from the hole the pieces of coal.

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